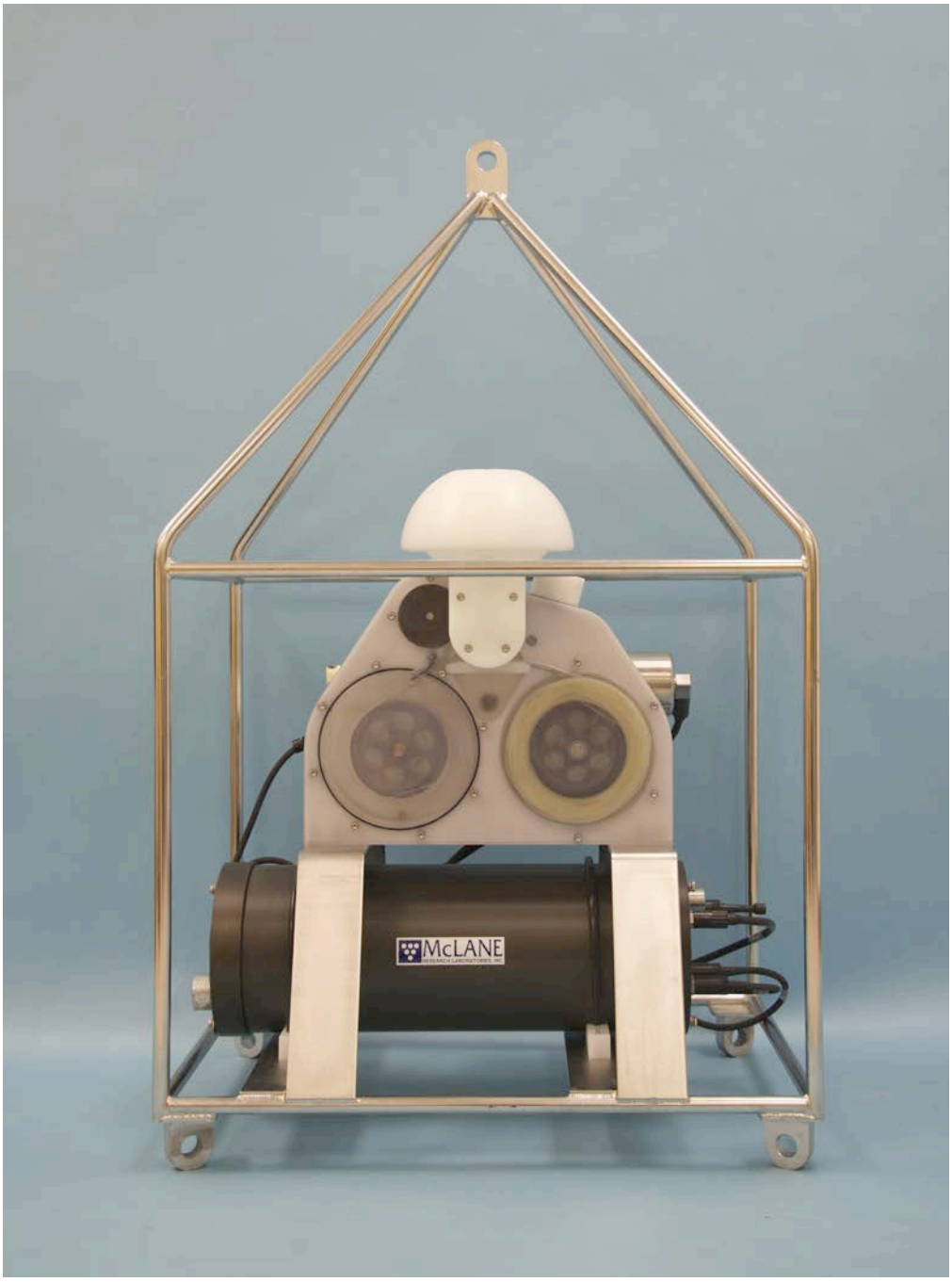
Profilers Samplers Flotation

mclanelabs.com

Zooplankton Sampler

User Manual



©2015 McLane Research Laboratories, Inc., Rev. B

Tel: +1 (508) 495-4000
mclane@mclanelabs.com
Skype: mclane_research
www.mclanelabs.com

ZPS User Manual Table of Contents

Chapter Introduction 1-1
McLane Zooplankton Sampler (ZPS) Overview 1-1
ZPS Line Drawing 1-2
ZPS Specifications 1-3
ZPS Components 1-4
ZPS Material 1-5
ZPS Toolkit 1-6
Customer Support Resources 1-7
McLane and Firmware Information 1-7
Technical Support 1-7
Instrument Training 1-7
Chapter 2 Communicating with your McLane Instrument 2-1
Cable and COM Connectors 2-1
Motocross Terminal Emulator 2-2
Configuring Motocross 2-3
Capturing instrument output to a text file 2-5
Connecting COM Cable and Battery, Starting Firmware 2-7
Connecting COM Cable 2-7
Connecting Battery 2-7
Activating the Firmware 2-8
Troubleshooting Communication with your Instrument 2-8
Troubleshooting: Confirm correct Port # defined 2-8
Troubleshooting: Transmission Mode Toggle 2-9
Troubleshooting: USB Adaptor 2-9
Chpater 3 User Interface 3-1
Power-Up Sequence 3-1
The Main Menu 3-1
<1> Set Time 3-2
<2> Diagnostics 3-3
Low Battery Messages 3-3
<3> Manual Operation 3-4
<1> Advance belt one position 3-5
<2> Advance to end of belt (Moving the Belt onto the Take-up Reel) 3-6
<3> Run pump: forward 3-7
<4> Run pump: reverse 3-8
<5> Run pump: programmable 3-8
<4> Sleep 3-9

<5> Create Schedule 3-10
Sampling Schedule Options 3-10
<1> Enter each event time 3-11
<2> Enter start date & interval 3-11
<3> Enter start date and end date 3-11
<6> Deploy System 3-11
<7> Offload Data 3-12
<2> Display event summary data 3-14
<3> Display pump data 3-14
<4> EEPROM data backup cache 3-14
<8> Contacting McLane 3-15
Programming a Schedule and Deploying the ZPS 3-15
Sample Schedule 3-16
Deployment 3-18
Chapter 4 Mechanical Description 4-1
Frame 4-1
Controller Housing 4-2
Top and Bottom End Caps 4-3
End Cap Bulkhead Connectors 4-4
End Cap Bolts, Plastic Inserts and Screw Holes 4-4
Pump 4-5
Intake Dome 4-5
Sample Belt and Stepper Motor 4-6
Serial Number 4-7
Chapter 5 Electronics Description 5-1
Battery Connection 5-2
Chapter 6 Operations 6-3
Cleaning the Belt, Prefilter and Intake Path 6-3
Reassembling the Sample Belt 6-8
Estimated Battery Endurance 6-10
Example of Determining Battery Life for Three Month Deployment 6-10
Chpater 7 Deployment and Recovery 7-1
Launch Preparation 7-2
Recovery Procedure 7-2
Removing the Belt 7-2
Removing Zooplankton Specimens 7-3
Offloading Data 7-4
<1> Display ALL data 7-6
Chapter 8 Maintenance and Storage 8-1
Cleaning and Inspecting the Controller Housing 8-1
O-Rings 8-1
Sample Housing and Proximity Switch 8-2

Battery Maintenance 8-4
Battery Replacement 8-4
Backup Batteries 8-4
Storage 8-4
Appendix A Quick Reference to Sampling Parameters A-1
ZPS Sampling Parameters - Quick Reference A-1
Appendix B Training Videos B-1

ZPS User Manual List of Figures

Figure 1-1: ZPS Line Drawing – Overall View 1-2
Figure 1-2: ZPS Toolkit 1-6
Figure 1-2: McLane Contact Information 1-7
Figure 2-1: Cable Connector Styles 2-1
Figure 2-2: Computer COM Setup Styles 2-2
Figure 2-3: Change Default Settings for Sending Control Characters 2-3
Figure 2-4: Ctrl+C/Ctrl+V Transmits Control Characters 2-4
Figure 2-5: Communication Settings Configuration 2-4
Figure 2-6: Start and Stop Capture File 2-5
Figure 2-7: Overwrite or Append Capture File 2-6
Figure 2-8: Include Buffer Text? 2-6
Figure 2-9: Connecting Main Battery to the Electronics Stack 2-7
Figure 2-10: Configured for Character Transmission Mode 2-9
Figure 2-11: Configured for Windows Editing Mode – Do Not Use 2-9
Figure 3-1: Set Time 3-2
Figure 3-2: ZPS Main Menu 3-2
Figure 3-3: Diagnostics 3-3
Figure 3-4: Low Battery Voltage 3-3
Figure 3-5: Critically Low Battery Voltage 3-3
Figure 3-6: Critically Low Battery Voltage – Offload Data 3-4
Figure 3-7: Manual Operation Menu 3-4
Figure 3-8: <1> Advance Belt One Position 3-5
Figure 3-9: Advance to End of Belt 3-6
Figure 3-10: Run Pump: Forward 3-7
Figure 3-11: Run Pump: Reverse 3-8
Figure 3-12: Run Pump: Programmable 3-9
Figure 3-13: Suspend Mode 3-9
Figure 3-14: Enter Number of Events to Program 3-10
Figure 3-15: Schedule Menu 3-11
Figure 3-16: <1> Display All Data (1 of 2) 3-12
Figure 3-17: <1> Display All Data (2 of 2) 3-13
Figure 3-18: EEPROM Data Backup Cache 3-14
Figure 3-19: McLane Contact Information 3-15
Figure 3-20: Enter Number of Sampling Events 3-16

Figure 3-21: Schedule Menu 3-17
Figure 3-22: Schedule Verification 3-17
Figure 3-23: <6> Deploy – Schedule Confirmation 3-18
Figure 3-24: <6> Deploy – Sampling Parameters 3-19
Figure 3-25: Schedule Overlap Message 3-20
Figure 3-27: Diagnostics 3-20
Figure 3-28: Deploy – Proceed 3-21
Figure 4-1: ZPS Full View 4-1
Figure 4-2: ZPS Controller Housing 4-2
Figure 4-3: Controller Housing Top End Cap with O-Ring Seals 4-3
Figure 4-4: Controller Housing End Cap Bulkhead Connectors 4-4
Figure 4-5: Pump Head 4-5
Figure 4-6: Sample Belt 4-6
Figure 4-7: Proximity Switch 4-7
Figure 4-8: ZPS Serial Number Label 4-7
Figure 5-1: CF2 Four Board Stack 5-1
Figure 5-2: Microcontroller & Interface Board 5-1
Figure 5-3: Three Phase Board 5-1
Figure 5-4: AUX Stepper Board 5-1
Figure 5-5: Battery Connection 5-2
Figure 6-4: Reservoir O-Ring Cord and Rubber Flapper 6-5
Figure 6-5: Remove Sample Support Grid 6-6
Figure 6-6: Remove Prefilter Retaining Ring and Prefilter 6-4
Figure 6-7: Break in O-Ring Cord 6-7
Figure 7-1: Four-to-One Bridle Connection 7-1
Figure 7-2: Complete Belt Take-up 7-2
Figure 7-3: Offload/Display Data File 7-5
Figure 7-4: Begin Data Offload (All Data) 7-5
Figure 7-5: <1> Display All Data (1 of 2) 7-6
Figure 7-6: <1> Display All Data (2 of 2) 7-7
Figure 8-1: Fixative Reservoir Quick Disconnect 8-2
Figure 8-2: Proximity Switch Oil Reservoir 8-3
Figure 8-3: Oil Reservoir Fill Hole 8-3

Chapter 1
Introduction

McLane Zooplankton Sampler (ZPS)

This manual describes the operation and maintenance of the McLane Zooplankton Sampler (ZPS), a time-series instrument that collects and preserves up to 50 *in situ* zooplankton samples. Before deploying the ZPS, complete the following:

- Become familiar with the ZPS by reviewing this User Manual.
- Follow procedures to connect the battery.
- Install the sample belt.
- Establish communications between the ZPS and a computer, and see Chapter 3 in this User Manual, "ZPS User Interface" to program the deployment.
- Become familiar with the toolkit and media included with your instrument.

NOTE
The ZPS media included with a new instrument includes instructional videos. See Appendix B in this User Manual for more information about this material.

ZPS Overview

The ZPS is a self-contained, low-power instrument that collects up to 50 individual zooplankton samples onto mesh windows in a urethane sample belt on a user-defined schedule. A back flush can be programmed to clean the intake path between samples and further reduce biofouling.

The ZPS can be deployed for up to 12 months. Deployment duration is affected primarily by biofouling and the retention of sample fixative in the reservoir. A three month deployment will best preserve sample integrity. Operating temperature can range from 0º to +35ºC water and maximum depth is 5,000m.

In addition to the sampling schedule, fluid volume and flow rate can be user-defined. During the deployment, timing, flow, and electrical parameters are logged. This data is offloaded when the ZPS is recovered and used during sample analysis. Deployment modes include:

- Anchored mooring.
- Ocean floor bottom lander.
- Lowered from a ship (like a CTD sensor and Rosette sampler).

The ZPS components are:

- Controller housing
- Pump assembly
- Sample belt, belt drive assembly, and sample housing
- Intake assembly with prefilter

ZPS Line Drawing

The drawing in Figure 1-1 and the Specifications list that follows illustrate the ZPS major components and mechanical design.

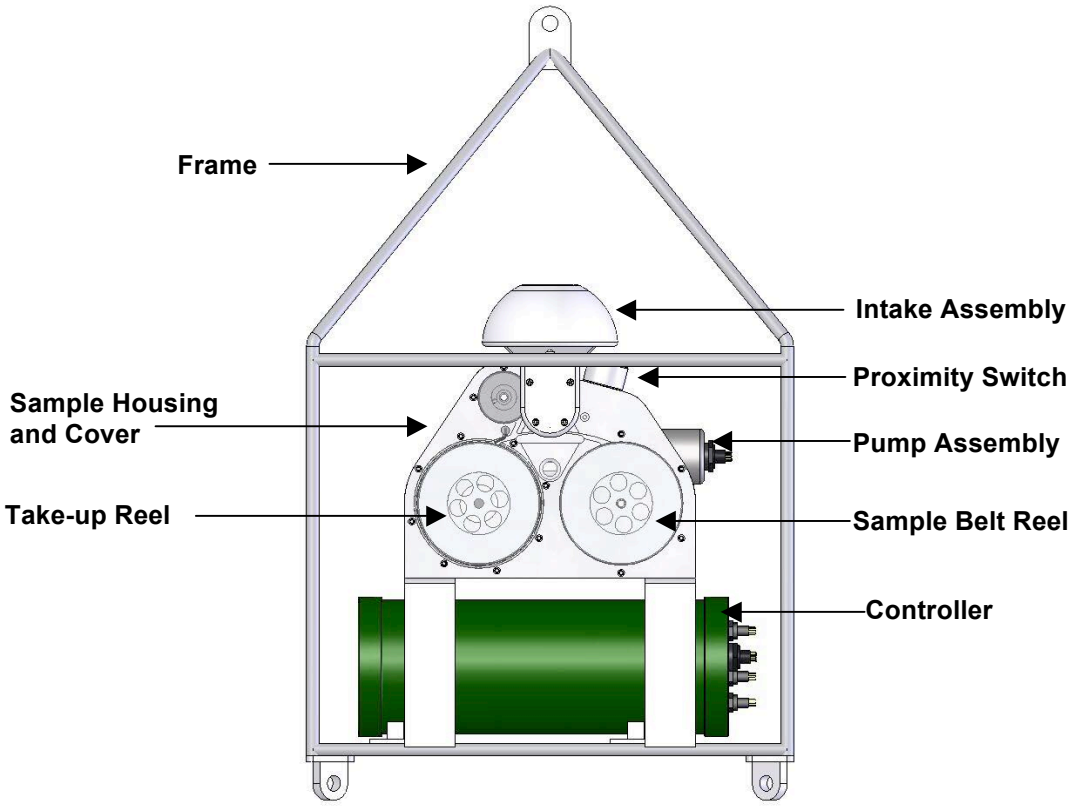


Figure 1-1: ZPS Line Drawing – Overall View

ZPS Specifications

Dimensions	Length	73 cm (29 in)
	Width	53 cm (21 in)
	Height	120 cm (47 in)
Weight	In air	102 kg (225 lbs)
	In water	68 kg (150 lbs)
Collector	Number of samples	50
	Sample window	4.8 x 9.5 cm
	Sample window and cover mesh	Pecap (polyester) 120 µm standard (50 – 500 µm available)
	Other belt materials	Urethane, sealed aluminum foil
	Recommended fixative	Glutaraldehyde/sea water buffer
	Materials	Polycarbonate and Acetal block
Pump	Flow rate	12 – 30 liters/minute
	Maximum total volume	25,000 liters
	Rec. volume/sample	250 liters
	Type	Rotary
	Volume error	±5% average
	Drive	Brushless 3 phase DC motor
Controller	Housing material	Aluminum, 6061-T6 hard coat anodized
	Power supply	36 VDC, 30Ahr alkaline battery pack
	Power consumption	7Ah (3 month deployment)
	Communications	Serial (RS-232)
Frame	Material	316 electro-polished stainless steel
	Structure and bridle config.	In-line mooring, weldment
	Frame & bridle eyes	19 mm diameter, insulated
	Max in-line tension	2,300 Kg (5,000 lbs)
Operation Conditions	Maximum depth	5,000 meters
	Max. deployment time	12 months (based on volume/flow rate) (3 months for sample integrity)
	Operating temperature	0 to 35° C

ZPS Components

The ZPS components are further described below.

Component	Description
Controller Housing	The controller housing is a hard coat anodized aluminum sealed pressure cylinder with a battery pack, micro-controller, 3-phase pump-motor driver, and a stepper-motor driver. The communication link between the ZPS and a computer is a standard, 3-wire, full duplex, RS-232 connection. The toolkit includes a USB to RS232 converter for computers that are not equipped with a serial port. Technical Bulletin 2014-06.1 has details about using the USB to RS232 converter.
Rotary Pump	The pump is positioned downstream from the sample belt, preventing damage to collected specimens (zooplankton do not pass through the pump during the collection process). The 3-phase motor is magnetically coupled to the pump head, which has a precisely machined, dual piston, rotary design that provides accurate and even flow throughout its range.
Sample Housing	The sample housing contains the sample belt, take-up reel, fixative reservoir and proximity switch.
Proximity Switch	The proximity switch (for pump position) is in the sample housing inside an oil-filled, pressure compensated reservoir.
Sample Belt	The sample belt is a continuous strip of polyester mesh sandwiched between urethane layers that contain sample windows. The Standard belt is 120 µm (other mesh from 50 – 500 µm is available). Each belt contains ~54 sample windows (50 can be used in each deployment). Secondary windows trail the larger sample windows to provide a flow path for water as the belt is advanced at the conclusion of each sample acquisition. Pumping continues at a reduced rate as the belt advances to prevent the escape of collected zooplankton. As the belt advances into the sample fixative reservoir, a second continuous strip of polyester mesh covers the sample window.

ZPS Material

The materials list provided next can be used to confirm chemical compatibility between the ZPS and any solutions used to clean the instrument.

Component	**Material**
Frame	316 electro polished stainless steel
Controller housing	6061-T6 Aluminum
Belt Motor Housing	White acetal
Sample Housing Cover	Polycarbonate
Pump Motor Housing	Titanium
Pump Head	Hydex® 4101, Ferralium, Techtron®

ZPS Toolkit

Each ZPS comes with a Toolkit that contains tools, software, and spare parts including:

- Backup batteries (AAA).
- Wrenches, screwdrivers, and hex drivers sized for the ZPS hardware.
- Spare o-rings, nylon and stainless steel screws and bolts.
- Spare polyurethane tubing.
- Communications cable for serial port connection to a computer.
- Media with the Motocross software and firmware documentation.
- USB to RS-232 connector.

Figure 1-2: ZPS Toolkit

Customer Support Resources

McLane Research Laboratories is on the Web at http://www.mclanelabs.com or via email at mclane@mclanelabs.com. The ZPS pages on the McLane website contain links to documentation including Technical Bulletins, and papers that describe the development and use of the ZPS.

McLane and Firmware Information

Option <8> from the profiler Main Menu interface also displays McLane contact information and the firmware version.

```
Selection [] ? 8

               McLane Research Laboratories, Inc.
                    Falmouth Technology Park
                121 Bernard E. Saint Jean Drive
               East Falmouth, MA 02536-4444  USA

                  Email: McLane@McLaneLabs.com
                 Web: http://www.McLaneLabs.com
             Tel: 508-495-4000  Fax: 508-495-3333

                     Configuration: ZPS-30G
                   Source file: CF2-2_02.c
                Electronics S/N: ML12345-01
                Compiled: Jul 23 2014 13:24
```

Figure 1-2: McLane Contact Information

Technical Support

When contacting McLane for technical support, please provide the following:

- Firmware version and instrument serial number. Serial number is printed on a silver label attached to the controller housing or on the Contact screen (Figure 1-2).
- A description of the problem.
- A text file of created using the Motocross file capture utility.

Instrument Training

McLane also offers a 1-2 day instrument training course at our facility free of charge with the purchase of a new instrument. Participants conduct trial deployments and work directly with members of the McLane engineering staff. Conducting trial deployments is a beneficial way to learn system operations before actual field investigations. For more product training information refer to www.mclanelabs.com.

Notes

Chapter 2
Communicating with your McLane Instrument

The ZPS toolkit includes a COM cable for connecting the sampler to a host computer. You must also install the Motocross terminal emulation program (MotoCrossML.exe) on the computer. Once the COM cable is connected to the sampler and host computer, connecting the main instrument battery powers on the firmware. The following topics are part of instrument connection:

- Cable and COM connectors
- Configuring MotoCrossML.exe
- Powering on the instrument (main battery connection)

Cable and COM Connectors

Locate the COM cable (in the instrument's toolkit) that connects the sampler and a computer. Determine whether the computer has a built-in serial port. Built-in serial ports are preferred for connection with your instrument. However, a USB to RS-232 adaptor is included in the toolkit for connection to computers without built in serial ports. The adaptor is a DS_US232R-10(R-100/500) adaptor cable (manufactured by FTDI Ltd).

The COM bulkhead connector is a 5-pin MCBH style. Some instruments may have a 3-pin XSG style bulkhead connector (Figure 2-1). Both style cables have a serial connector. The serial connector either plugs directly into the computer or into the USB to RS-232 adaptor and then into the computer (Figure 2-2).

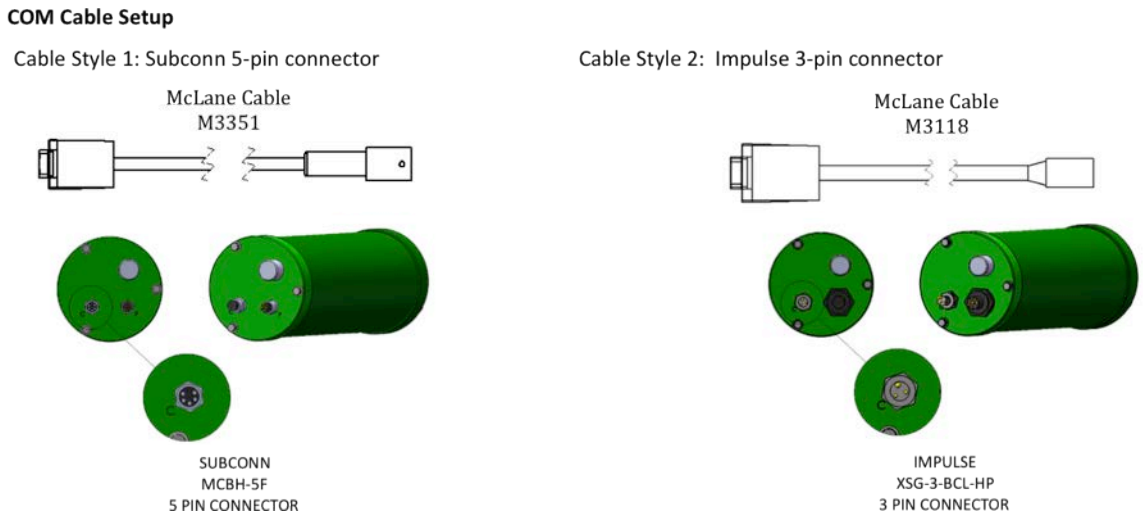


Figure 2-1: Cable Connector Styles

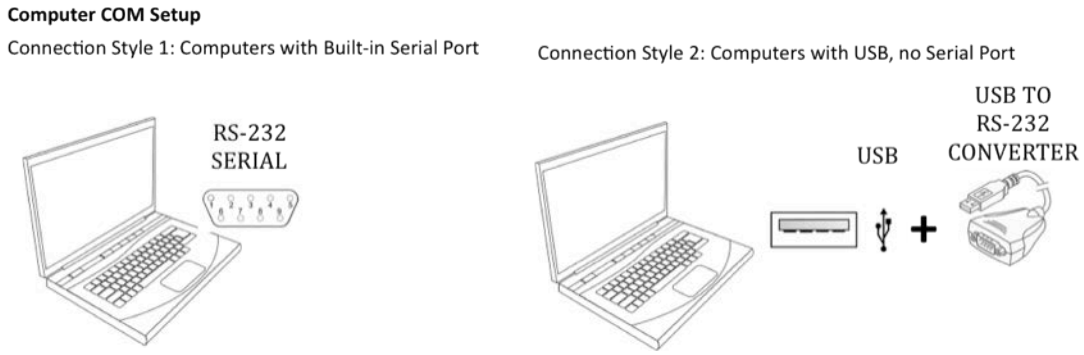


Figure 2-2: Computer COM Setup Styles

Motocross Terminal Emulator

Motocross is a terminal emulator for communicating with McLane samplers and profilers. McLane created a custom version of Motocross (MotoCrossML.exe), configured with the Motocross settings required by our instruments. Other Motocross considerations:

- A built-in Motocross feature can log communications with your instrument to a capture file located on the connected host computer. McLane recommends using capture file logging when running any bench tests or setting up a deployment.

IMPORTANT
McLane instruments require Motocross [CTRL]-C keystrokes to be configured as character transmissions for canceling operations, waking from Suspend mode, and navigating menus. The other Motocross Transmission mode, Standard Windows Editing mode, uses [CTRL]-C as a text copy function and is not recognized by McLane instrument operations.

- MotoCrossML.exe is included on the media shipped with a new instrument and is available at www.mclanelabs.com under Support > Software Utilities.

Configuring Motocross

1. Install MotocrossML.exe. (from the media included with your instrument) on a computer.
2. Open MotocrossML.exe. MotocrossML.exe is configured with the settings required by our instruments, however some setup is still needed.

IMPORTANT
Running a Motocross executable other than the program provided by McLane (MotoCrossML.exe) will not make the necessary configuration changes for using Motocross terminal emulation with McLane instruments.

3. Confirm that "Transmit Control Characters" (Figure 2-3) is enabled. From the top menu bar, select the Edit menu. Confirm Copy-Paste Options are set to transmit control characters (Figure 2-4), click OK.

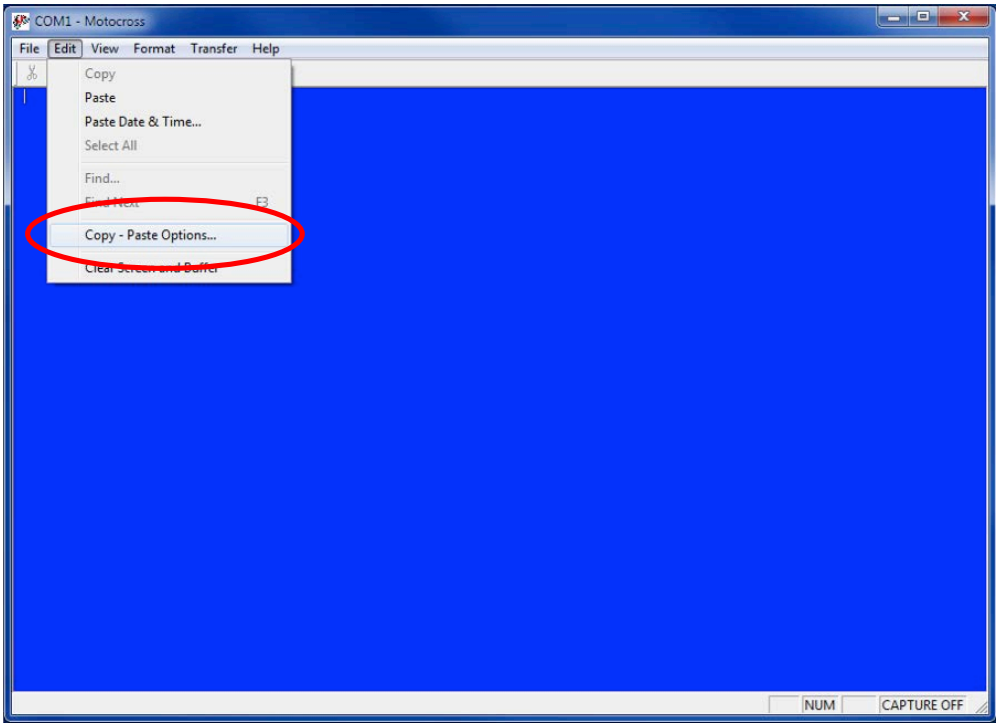


Figure 2-3: Change Default Settings for Sending Control Characters

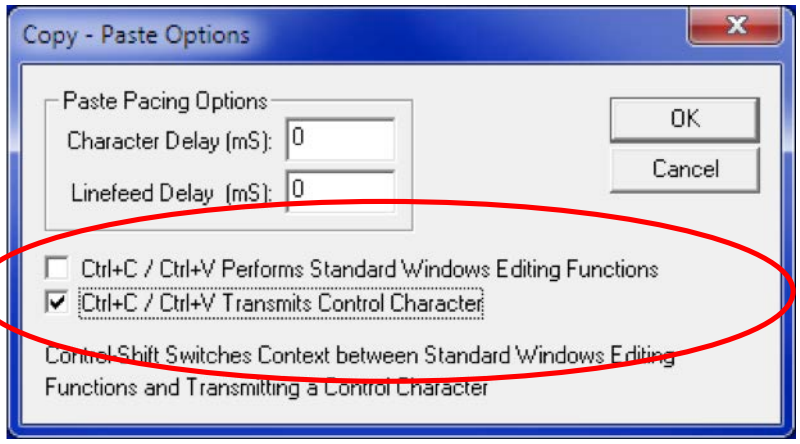

Copy - Paste Options
Paste Pacing Options
Character Delay (mS): 0
Linefeed Delay (mS): 0
OK
Cancel
Ctrl+C / Ctrl+V Performs Standard Windows Editing Functions
Ctrl+C / Ctrl+V Transmits Control Character
Control-Shift Switches Context between Standard Windows Editing Functions and Transmitting a Control Character

Figure 2-4: Ctrl+C/Ctrl+V Transmits Control Characters

4. From the File menu, select "Communication Settings" (Figure 2-5). Set parameters as follows and click OK:
    - Port # (the connected port).
    - Baud Rate: 9600 baud
    - Parity: None
    - Data Bits: 8
    - Flow Control: None

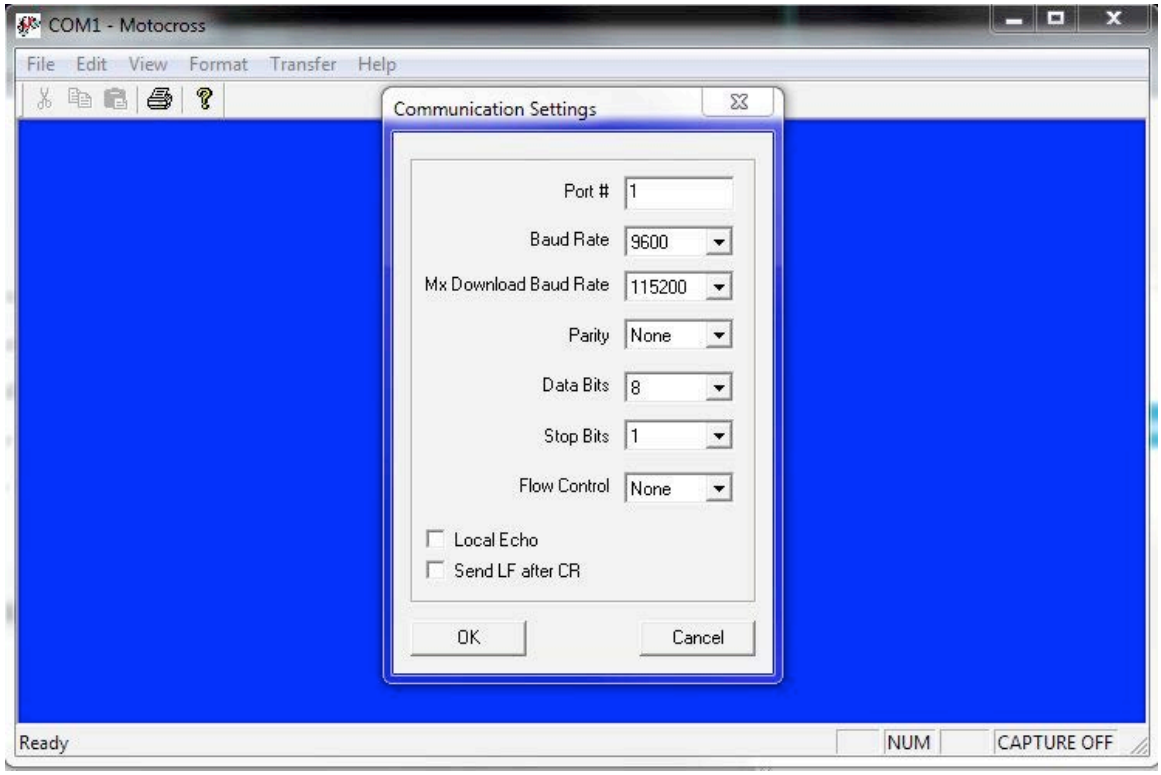


Figure 2-5: Communication Settings Configuration

Capturing instrument output to a text file

A built-in Motocross feature will log all communications to a capture file located on the connected host computer. This capture file is a very useful troubleshooting tool. McLane recommends setting up a capture file while running any bench tests or setting up a deployment.

1. Click the Transfer Menu.
2. Select “Capture Text”.
3. Enter a file name and location for the capture file.
4. Click “Start”.

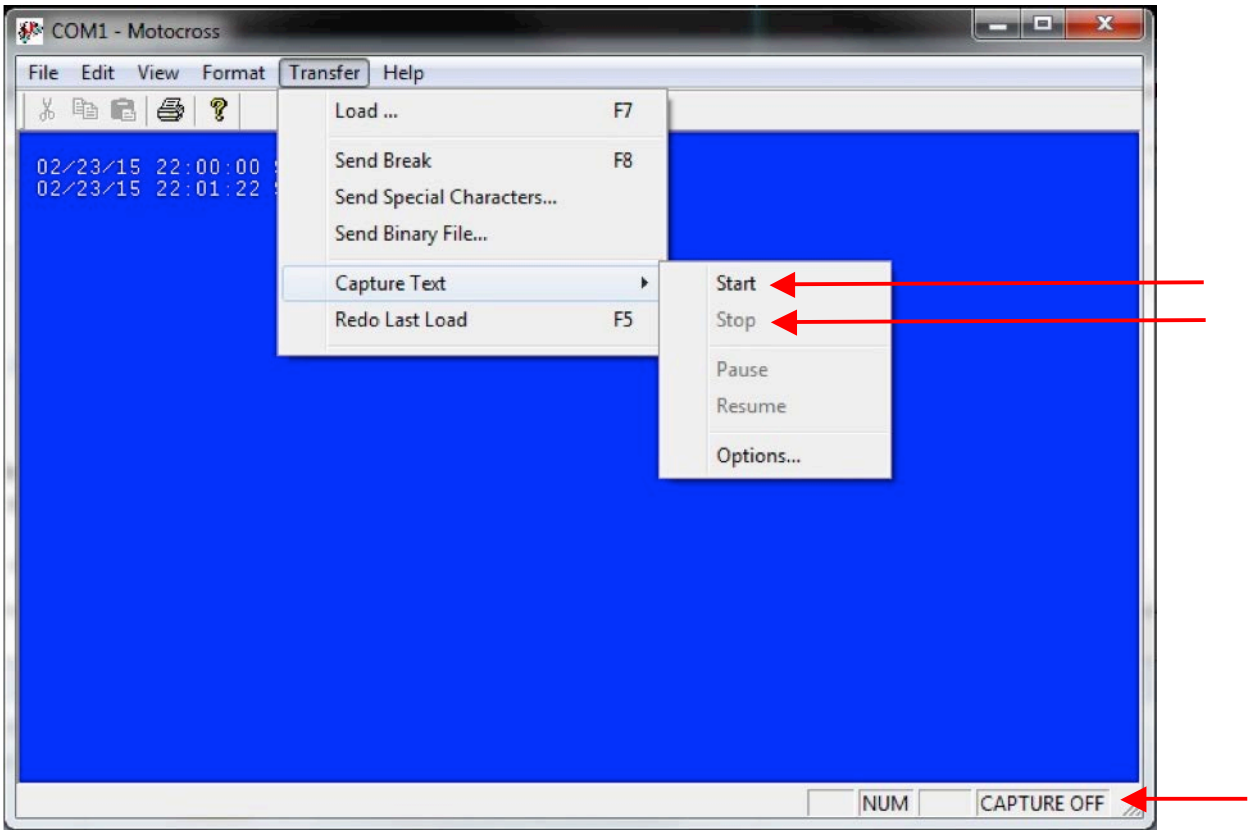


Figure 2-6: Start and Stop Capture File

5. Select whether to Append or Overwrite the file (Figure 2-7). Use caution when making this selection. Overwrite replaces any information in the log file. Append adds new information to the file.

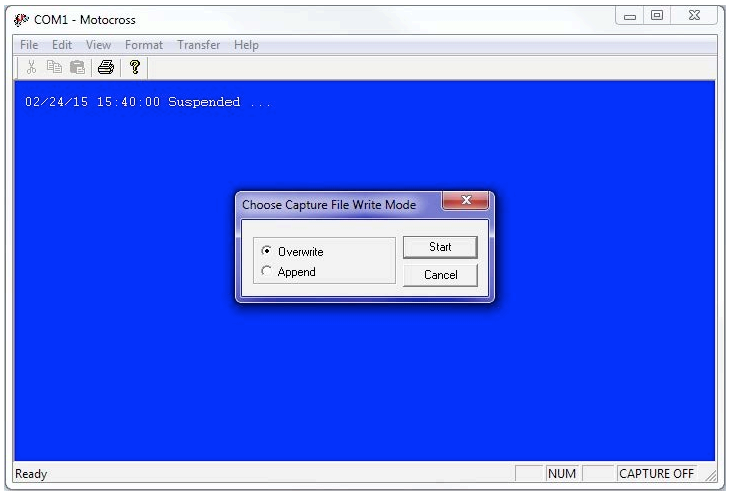


Figure 2-7: Overwrite or Append Capture File

6. Click "No" when prompted whether or not to include the Buffer text (Figure 2-8).

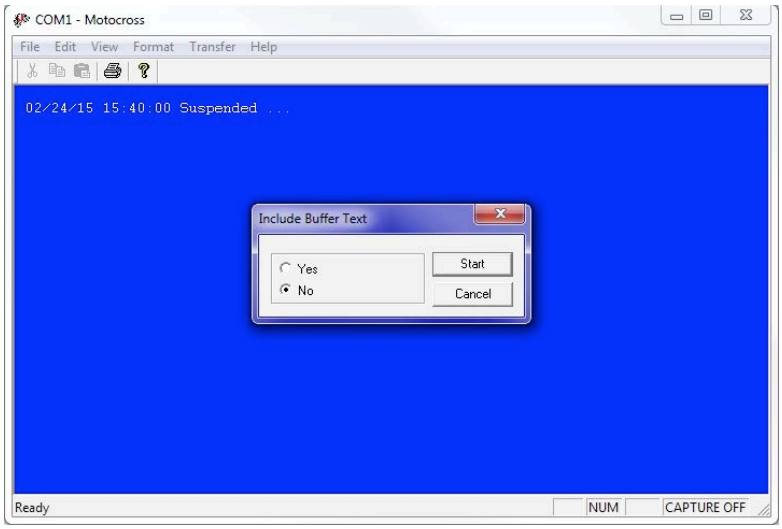


Figure 2-8: Include Buffer Text?

7. To finish capturing to file, select "Capture Text" from the Transfer menu (Figure 2-6) and then click "Stop" in the Transfer menu.

Connecting COM Cable and Battery, Starting Firmware

Connecting COM Cable

1. Place the ZPS in a dry area.
2. With Motocross running, remove the dummy plug from the COM connector on the controller housing end cap.
3. Connect the COM cable to the computer serial communication port (use the USB to RS232 Adaptor, if the computer does not have a built in serial port). Make this connection before connecting to the COM connector on the controller end cap.
4. Connecting to the COM bulkhead connector on the controller end cap.

Connecting Battery

1. Open the controller housing by unscrewing the three (3) bolts from the end cap (the cap on which the connectors are mounted).
2. Pull the end cap straight out from the cylinder (the electronics stack is mounted to this cap).
3. Grasp the main battery connector.

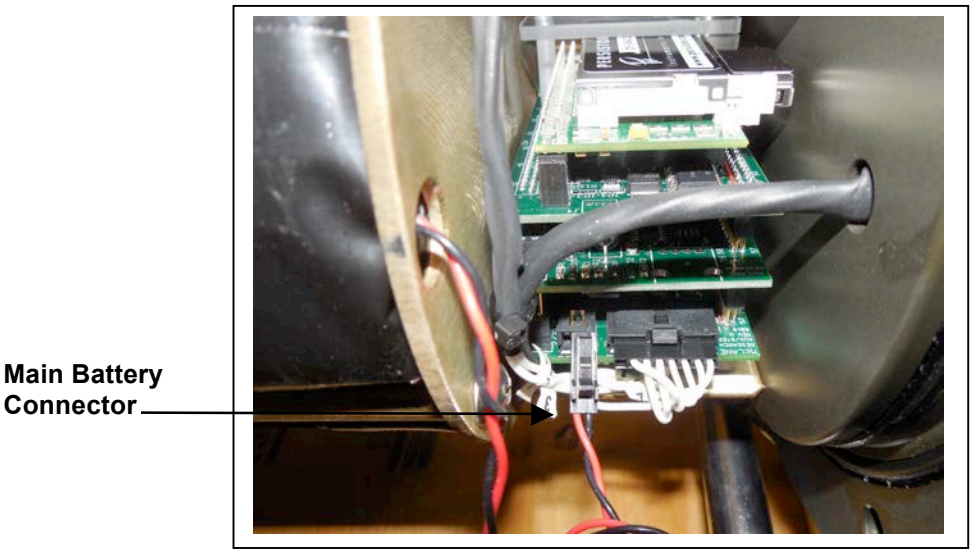


Figure 2-9: Connecting Main Battery to the Electronics Stack

4. Connect the main battery to the 2-pin connector on the middle board of the electronics stack.
5. The system initialization will begin (see Chapter 3, "User Interface" for details on the system initialization and firmware menus).

Activating the Firmware

1. After system initialization, the Main Menu displays.
2. Press [CTRL]-C three times (with three second pauses between each) to display the Main Menu.

NOTE
Only one [CTRL]-C is needed to control the firmware if the device is not in Suspend mode.

NOTE
Disconnect the main battery before shipping to prevent electrical system damage during transit. Before disconnecting. power, press [CTRL]-[C], to return to the Main Menu and put the sampler in Suspend mode.

Troubleshooting Communication with your Instrument

Troubleshooting: Confirm correct Port # defined

If the instrument firmware does not respond when connected to Motocross, use these steps to troubleshoot:

- Confirm the battery is connected to the instrument.
- Verify the correct Port # is defined (Figure 2-5).
- Ensure that character transmission mode is set (Figure 2-4).
- Read below for information on the toggle that changes Transmission mode.

Troubleshooting: Transmission Mode Toggle

It is possible to mistakenly switch between Control Character mode, and standard Windows Editing functions by holding down the [CTRL] key and pressing the Shift key. If Motocross does not respond as expected, press [CTRL]-Shift to toggle back to Character Transmission mode if needed.

Figure 2-10: Configured for Character Transmission Mode

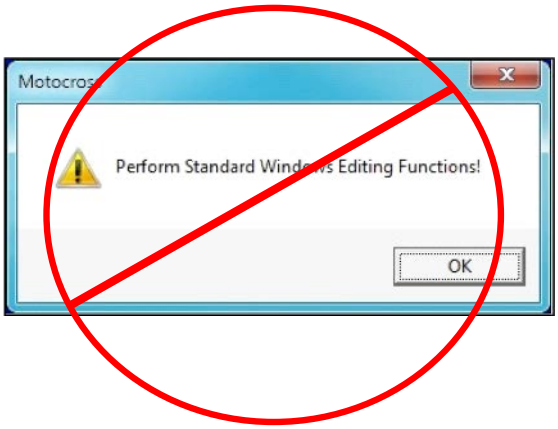


Figure 2-11: Configured for Windows Editing Mode – Do Not Use

Troubleshooting: USB Adaptor

The USB adaptor has LED indicator lights for transmitting and receiving data. Typing any key in Motocross terminal emulation should be indicated by the LED. If no LED light flashes on keystrokes, you may have selected the incorrect COM Port. Refer to the section that follows for instructions on Motocross setup.

Notes

Chapter 3
User Interface

This chapter describes firmware menus, commands, and screens and provides steps to program a ZPS deployment.

NOTE
McLane recommends starting a capture file when operating the firmware. The Motocross Terminal Emulator (included on the media shipped with the instrument) has a built-in feature that logs communications to a capture file located on the connected Host computer. See Chapter 2 in this User Manual for detailed information about Motocross.

Power-Up Sequence

Connecting the main battery automatically starts the firmware (and is the only way to power on the ZPS). When the power-up sequence begins, a time and date prompt displays.

NOTE
If the battery has been connected for some time and time/date do not display, pressing [CTRL]-[C] three times (pausing one second between key presses) wakes the firmware from Suspend mode. If date/time still do not display, see Chapter 2 in this User Manual to troubleshoot operation with the Motocross Terminal emulator.

The Main Menu

The Main Menu provides the menu selections for all firmware operations. To select an option, type the appropriate character and press [ENTER].

NOTE
Pressing [ENTER] accepts the default for most prompts in the firmware.

```
_____________________________________________________________________

Configuration: ZPS-30G                      CF2 V2_02 of Jul 23 2014

               McLane Research Laboratories, Inc.
                      ZooPlankton Sampler
                           ML12345-01
               _____________________________________

                           Main Menu
               _____________________________________

                   Fri Feb 13 11:10:53 2015

                      Belt is NOT aligned

          <1> Set Time          <5> Create Schedule
          <2> Diagnostics       <6> Deploy System
          <3> Manual Operation  <7> Offload Data
          <4> Sleep             <8> Contact McLane
```

Figure 3-1: ZPS Main Menu

<1> Set Time

This option sets or adjusts the real time clock (RTC). Use this option to change the date and/or time setting if adjustments are required after initially setting the RTC during the power-up sequence. At the start of the power up sequence, the clock defaults to January 1, 1970, 00:00:00. The date and time can be set to any values in the allowed range (up to the Year 2038) and the count will continue from the new value.

```
Clock reads 02/13/15 11:10:45.  Change [N] ? y
Format is mm/dd/[yyyy or yy] hh:mm:ss
Enter correct time [02/13/2015 11:10:47] ? 02/13/2015 11:10:52

Clock reads 02/13/15 11:10:52.  Change [N] ?
```

Figure 3-2: Set Time

IMPORTANT
Set the RTC during the power-up sequence and use the Set Time option only to adjust the date and/or time.

<2> Diagnostics

Diagnostics scrolls a status display including date, time, battery voltage (marked Vb) temperature inside the controller housing (in Celsius) and belt status. To exit Diagnostics and return to the Main Menu press [X] or [CTRL]-[C]. Pressing any other key toggles scrolling on and off.

NOTE
Diagnostics will continue to scroll until the user stops the program. The automatic Suspend mode after 20 minutes if inactivity is surpressed during the diagnostics scroll.

```
                  Selection [] ? 2
Press ^C to exit - any other key to pause/continue display
02/17/15 11:44:04  35.8Vb  0mA  20.9C  Belt is aligned
02/17/15 11:44:05  35.8Vb  0mA  21.0C  Belt is aligned
02/17/15 11:44:06  35.8Vb  1mA  21.0C  Belt is aligned
```

Figure 3-3: Diagnostics

Low Battery Messages

Low battery voltage will trigger warning messages during the exit from Diagnostics. If the main battery pack falls below 32 V, a message displays to replace the battery before deployment.

```
WARNING: Battery voltage is abnormally low.
Check/replace main battery before deploying.
Press any key to continue.
```

Figure 3-4: Low Battery Voltage

If the main battery pack falls below 20 V, the Diagnostic program terminates and displays the message below before returning to the Main Menu.

```
WARNING: Low battery!02/25/15 14:30:59  13.8Vb  0mA  21.3∞C  Belt is aligned
```

Figure 3-5: Critically Low Battery Voltage

If a critically low battery (below 20 V) is detected and a data file exists in memory that has not been offloaded, the additional warning below displays before returning to the Main Menu.

```
A data set exists in memory that has not been offloaded. Offload the data
now, before replacing battery, or the data may be lost.
```

Figure 3-6: Critically Low Battery Voltage – Offload Data

IMPORTANT

Confirm that offloaded data is accurate before disconnecting the battery. The firmware detects only the successful execution of the Offload Data option and not whether the data file was successfully logged by Motocross.

<3> Manual Operation

Manual Operation provides direct control of the belt and pump for bench testing, belt alignment, and deployment preparation. Options 1 and 2 move the belt. Options 3, 4, and 5 run the pump.

IMPORTANT

Do not run the pump dry. If conducting a bench test, submerge the ZPS in water before committing to the deployment.

```
Selection [] ? 3
_____________________________________________________________________

Configuration: ZPS-30G                 CF2 V2_02 of Jul 23 2014
                _____________________________________
                          Manual Operation
                _____________________________________
                    Fri Feb 13 11:13:18 2015
                       Belt is NOT aligned
                 <1> Advance belt one position
                 <2> Advance to end of belt
                 <3> Pump forward 30L @ 20L/min
                 <4> Pump reverse 30L @ 20L/min
                 <5> Pump programmable
                 <M> Main Menu
```

Figure 3-7: Manual Operation Menu

<1> Advance belt one position

This option allows a manual, continual, frame-by-frame advance of the belt to the next sample position.

IMPORTANT
Use Option <1> only to advance frame by frame, not to move the belt onto the take-up reel. Option <2> 'Advance to end of belt' should be used move the belt onto the take-up reel as this option has a timed pause to safely prevent overheating the electronics.

```
_____________________________________________________________

Configuration: ZPS-30G                  CF2 V2_02 of Jul 23 2014

                  _____________________________
                           Manual Operation
                  _____________________________

                      Fri Feb 13 11:16:44 2015

                         Belt is NOT aligned

                   <1> Advance belt one position
                   <2> Advance to end of belt
                   <3> Pump forward 30L @ 20L/min
                   <4> Pump reverse 30L @ 20L/min
                   <5> Pump programmable

                   <M> Main Menu

                   Selection [] ? 1

02/13/15 11:16:47 Advancing belt to next sample position ... done
```

Figure 3-8: <1> Advance Belt One Position

<2> Advance to end of belt (Moving the Belt onto the Take-up Reel)

This option moves the belt completely off the source spools and onto the take-up reel in the fixative reservoir. Pressing [CTRL]-[C] stops this process.

```
_____________________________________________________________________

Configuration: ZPS-30G                 CF2 V2_02 of Jul 23 2014
                 ___________________________________
                          Manual Operation
                 ___________________________________
                     Wed Feb 25 14:06:52 2015

                        Belt is NOT aligned

                  <1> Advance belt one position
                  <2> Advance to end of belt
                  <3> Pump forward 30L @ 20L/min
                  <4> Pump reverse 30L @ 20L/min
                  <5> Pump programmable

                  <M> Main Menu

                  Selection [] ? 2

Belt take-up requires 1 minute per remaining sample.

Take-up may be completed by hand.

Operation can be terminated with ^C

Continue with belt take-up [Y] ? y

02/25/15 14:07:27 Beginning belt take-up .....
02/25/15 14:08:30 33 second pause for heat dissipation (1 of 60)
02/25/15 14:07:57 Suspended until 02/25/15 14:08:30 ...  Awake
02/25/15 14:08:31 Continuing belt take-up ...  [^C]
```

Figure 3-9: Advance to End of Belt

<3> Run pump: forward

This option pumps 30 liters of water at 20 L/min in the forward direction. Pressing [CTRL]-[C] stops the pump. Each row shows the pump control value, the instantaneous pump speed (in Hertz), the average pump speed (in Hertz), the cumulative volume pumped (in liters), the instantaneous flow rate (in liters per minute), and the elapsed time (in seconds).

```
                Selection [] ? 3

WARNING: Belt may not be aligned!

Do you wish to proceed [N] ? y

  2529 h  358 I_Hz   89 A_Hz   0.3 L 19.2 L/min     1 secs  4095P 35.7V 736mA
  2461 h  407 I_Hz  191 A_Hz   0.7 L 21.8 L/min     2 secs  2102P 35.7V 639mA
  2436 h  385 I_Hz  287 A_Hz   1.0 L 20.7 L/min     3 secs  2323P 35.7V 633mA
  2429 h  376 I_Hz  381 A_Hz   1.3 L 20.2 L/min     4 secs  2533P 35.7V 634mA
  2431 h  372 I_Hz  385 A_Hz   1.6 L 20.0 L/min     5 secs  2739P 35.7V 633mA
.  .  .
  2396 h  372 I_Hz  373 A_Hz  29.2 L 20.0 L/min    91 secs  2721P 35.7V 588mA
  2395 h  373 I_Hz  372 A_Hz  29.5 L 20.0 L/min    92 secs  2721P 35.7V 591mA
  2395 h  373 I_Hz  373 A_Hz  29.8 L 20.0 L/min    93 secs  2719P 35.7V 590mA

02/13/15 11:15:01 Volume reached

Total volume pumped     = 30.01 L
Elapsed time of event   = 94 sec
Lowest battery detected = 35.7 Vb
Highest pump current detected = 736 mA

 Press any key to continue.
```

Figure 3-10: Run Pump: Forward

<4> Run pump: reverse

This option pumps 30 liters of water at 20 L/min in the reverse direction. Pressing [CTRL]-[C] stops the pump.

```
Selection [] ? 4

WARNING: Belt may not be aligned!

Do you wish to proceed [N] ? y

  2565 h  340 I_Hz   85 A_Hz   0.3 L 18.2 L/min     1 secs  4095P 35.6V 890mA
  2499 h  406 I_Hz  186 A_Hz   0.6 L 21.8 L/min     2 secs  2095P 35.7V 770mA
  2470 h  387 I_Hz  283 A_Hz   1.0 L 20.8 L/min     3 secs  2314P 35.7V 735mA
  2461 h  377 I_Hz  377 A_Hz   1.3 L 20.2 L/min     4 secs  2525P 35.7V 727mA
  2459 h  374 I_Hz  386 A_Hz   1.6 L 20.1 L/min     5 secs  2731P 35.7V 725mA
.  .  .

  2468 h  373 I_Hz  372 A_Hz  29.1 L 20.0 L/min    91 secs  2721P 35.6V 784mA
  2469 h  372 I_Hz  372 A_Hz  29.5 L 20.0 L/min    92 secs  2720P 35.7V 775mA
  2471 h  372 I_Hz  372 A_Hz  29.8 L 20.0 L/min    93 secs  2720P 35.6V 773mA

02/13/15 11:16:43 Volume reached

Total volume pumped     = 30.00 L
Elapsed time of event   = 95 sec
Lowest battery detected = 35.6 Vb
Highest pump current detected = 890 mA

 Press any key to continue.
```

Figure 3-11: Run Pump: Reverse

<5> Run pump: programmable

This option sets an operator-entered volume, flow rate, minimum flow rate, and time limit for pumping. Pressing [CTRL]-[C] stops the pump.

NOTE

If the belt is not aligned, the firmware displays a warning message (see Figure 7-13). Typing 'Y' proceeds with the programmable pump schedule.

```
Configuration: ZPS-30G                  CF2 V2_02 of Jul 23 2014

                  ____________________________________
                           Manual Operation
                  ____________________________________
                      Wed Feb 25 14:08:45 2015

                         Belt is NOT aligned

                   <1> Advance belt one position
                   <2> Advance to end of belt
                   <3> Pump forward 30L @ 20L/min
                   <4> Pump reverse 30L @ 20L/min

                   <5> Pump programmable

                   <M> Main Menu

                   Selection [] ? 5

WARNING: Belt may not be aligned!  <-------- Alignment warning

Do you wish to proceed [N] ? y

Enter volume per sample  [liters]     ( 1-30000) [  30] ? 200     Allowed range
Enter pumping flow rate  [liters/min]  (12-  30) [  20] ? 15      is calculated
Enter minimum flow rate  [liters/min]  (10-  15) [  10] ? 12      based on
Enter pumping time limit [minutes]     ( 1-  17) [  17] ? 16  <-- Volume per
                                                                  sample and
Forward or Reverse pumping [F] ? r                                Flow Rates

  2365 h  347 I_Hz   86 A_Hz   0.3 L 18.6 L/min     1 secs  4095P 33.9V 475mA
  2222 h  351 I_Hz  174 A_Hz   0.6 L 18.8 L/min     2 secs  2161P 34.0V 405mA
  2193 h  294 I_Hz  248 A_Hz   0.8 L 15.8 L/min     3 secs  2351P 33.9V 410mA
  2200 h  276 I_Hz  317 A_Hz   1.1 L 14.8 L/min     4 secs  2515P 33.9V 432mA
  2204 h  277 I_Hz  299 A_Hz   1.3 L 14.9 L/min     5 secs  2665P 33.9V 426mA
```

Figure 3-12: Run Pump: Programmable

<4> Sleep

Sleep places the controller in Suspend mode to minimize battery drain. Suspend mode also triggers automatically when there is no keyboard activity for 20 minutes. The controller enters Suspend mode during the intervals between events and after the last scheduled event is completed. To wake the firmware and return to the Main Menu, press [CTRL]-[C] three times, (with three second pauses between each).

```
                Selection [] ? 4


02/13/15 11:17:16 Suspended ...
02/13/15 11:20:01 Suspended ...
02/13/15 11:40:00 Suspended ...
02/13/15 12:00:00 Suspended ...
02/13/15 12:20:00 Suspended ...
```

Figure 3-13: Suspend Mode

<5> Create Schedule

Create Schedule defines an operator-created sampling schedule in advance of the actual deployment. The schedule consists of dates and times that triggers pumping events, and specifies the number of samples to be taken (from 0 through 50).

NOTE
Specific steps for creating a schedule are provided in the "Programming a Schedule and Deploying the ZPS" section at the end of this Chapter.

IMPORTANT
Creating a new schedule erases data already in memory.

Sampling Schedule Options

When <5> is selected, a prompt displays to enter the number of events to program. The default is 50.

```
_____________________________________________________________________
Configuration: ZPS-30G                  CF2 V2_02 of Jul 23 2014

               McLane Research Laboratories, Inc.
                      ZooPlankton Sampler
                           ML12345-01

               _____________________________
                           Main Menu
               _____________________________
                   Wed Feb 25 14:11:55 2015

                      Belt is NOT aligned

           <1> Set Time          <5> Create Schedule
           <2> Diagnostics       <6> Deploy System
           <3> Manual Operation  <7> Offload Data
           <4> Sleep             <8> Contact McLane

                Selection [] ? 5

Existing deployment data file will be erased. Continue [N] ? y

Enter new deployment schedule [N] ? y

Current value of number of events to program: 50

Enter number of events to program (0-50) [50] ? 40
```

Figure 3-14: Enter Number of Events to Program

The Schedule Menu displays after defining the number of events to program.

```
Configuration: ZPS-30G                  CF2 V2_02 of Jul 23 2014

                  ____________________________________
                            Schedule Menu
                  ____________________________________
                      Tue Feb 17 11:44:40 2015

                   <1> Enter each event time
                   <2> Enter start date & interval
                   <3> Enter start date & end date

                   <M> Main menu

                   Selection [1] ? 2
```

Figure 3-15: Schedule Menu

<1> Enter each event time

This option allows entry of all events one at a time (month, day, year, hour, minute and second). The firmware automatically sorts events so that it is unnecessary to enter them in chronological order.

<2> Enter start date & interval

This option allows entry of a start date and different time intervals between sampling event start times. The intervals are entered in days, hours and/or minutes.

<3> Enter start date and end date

This option schedules sampling events at regular intervals between start and end dates.

<6> Deploy System

Once the sampling schedule is created, selecting Deploy System does the following:

- Confirms that the belt is aligned to the next window.
- Warns if there is data ready to be offloaded.
- Changes or keeps the existing sampling schedule.
- Confirms the date and time.
- Displays a final sampling parameter check with options to make changes.

After the schedule and date/time are confirmed, the final check is performed and a final prompt is displayed. Selecting 'Yes' at the final prompt commits the firmware to the

deployment. The firmware enters Suspend mode where no further user entries (except [CTRL]-[C]) are allowed.

NOTE
Specific steps for using this option to deploy the ZPS are provided in the section "Programming a Schedule and Deploying the ZPS" at the end of this Chapter.

<7> Offload Data

This option works with the 'Capture to file' feature of Motocross. Offload data before disconnecting the battery to prevent data loss. After recovering the ZPS and re-establishing the computer communications link, select <7> Offload Data to capture data to a text file.

NOTE
Specific steps for using this option to offload deployment data are provided in Chapter 7 'Deployment and Recovery' in this User Manual.

Screens for the Display ALL Data option are shown in Figures 3-16 and 3-17.

```
Selection [] ? 7
_____________________________________________________________
Configuration: ZPS-30G                  CF2 V2_02 of Jul 23 2014
                _____________________________
                    Offload/Display Data File
                _____________________________
                    Tue Feb 17 13:34:46 2015
                 <1> Display all data
                 <2> Display summary data
                 <3> Display pump data
                 <4> EEPROM backup cache
                 <M> Main Menu
                 Selection [] ? 1
To copy the instrument data file to a disk file, initiate
your communication program's file logging command now and
then press any key to start the transfer.  The instrument
data file will remain resident and is not erased by this
offload procedure.
Configuration:     ZPS-30G
Software version:  ZPS-2_02.c
Compiled:          Jul 23 2014 13:24:38
Electronics S/N:   ML12345-01
Data recording start time: 02/17/15 11:47:12
Data recording  stop time: 02/17/15 13:08:14
```

Figure 3-16: <1> Display All Data (1 of 2)

```
HEADER

______
Bench Test, 2-17-2015
s/n 12345-01
FJH

SAMPLE PARAMETERS

_________________

Initial flow rate:     20 liters/minute
Minimum flow rate:     10 liters/minute
Sample volume:         40 liters
Time limit:             5 minutes
Back flush volume:      5 liters
Back flush interval:  720 minutes
Sample delay:           5 minutes

SCHEDULE

________
Event 01 of 08 @ 02/17/15 11:50:00
Event 02 of 08 @ 02/17/15 12:00:00
Event 03 of 08 @ 02/17/15 12:10:00

DEPLOYMENT DATA

_______________
  1  02/17/15 11:50:02  35.8 Vb   21 ºC
     Intake flush    5.00 L       16 sec  35.6 Vbl  Volume reached
     Sample         42.30 L      141 sec  35.7 Vbl  Volume reached
     02/17/15 11:57:58  35.8 Vb   22 ºC
     Sample successfully sealed

  2  02/17/15 12:00:01  35.8 Vb   23 ºC
     Intake flush    5.00 L       16 sec  35.6 Vbl  Volume reached
     Sample         42.31 L      141 sec  35.7 Vbl  Volume reached
     02/17/15 12:07:57  35.8 Vb   23 ºC
     Sample successfully sealed

3  02/17/15 12:10:02  35.8 Vb   24 ºC
     Intake flush    5.00 L       16 sec  35.6 Vbl  Volume reached
     Sample         42.31 L      141 sec  35.7 Vbl  Volume reached
     02/17/15 12:17:57  35.8 Vb   23 ºC
     Sample successfully sealed
.  .  .  <-- Display shortened for brevity

PUMPING DATA

____________
Sample interval: 1 minute
event  L/min  Liters  Vbat
    1  19.96   19.25  35.7
    1  19.96   38.46  35.7
    2  19.96   19.26  35.7
    2  20.02   38.47  35.7
    3  20.02   19.26  35.7
    3  20.02   38.47  35.7
.  .  .  <-- Display shortened for brevity
End of instrument data file.

Terminate file logging operation now.
Press any key to continue.
```

Figure 3-17: <1> Display All Data (2 of 2)

Options <2>, <3> and <4> are described in the sections that follow.

<2> Display event summary data

'Display event summary data' displays the programmed pumping values and the event summary data (total volume pumped, start/stop times).

<3> Display pump data

'Display pump data' displays the programmed pumping values and the pumping time history (flow rates, cumulative volumes, and battery voltages).

<4> EEPROM data backup cache

'EEPROM data backup cache' accesses a backup copy of the most critical deployment data from non-volatile memory. Note that only the most critical data for sample processing is included. An example of Option 4 output is shown next.

```
Selection [] ? 4

During deployments a backup copy of the most important

information stored in the instrument datafile is also written
to a small EEPROM.  The EEPROM provides non-volatile data
storage, allowing data recovery in the unlikely event the
instrument datafile is no longer resident in active memory.

The EEPROM data cache contains the start and stop time for
each sampling event that occurred and the volume of water
pumped through the belt during the event.

To copy the EEPROM cache file to a disk file, initiate your
communication program's file logging command now and then press
any key to start the transfer.  The cache file remains resident
in the EEPROM until overwritten during the next deployment.

  1  02/17/15 11:50:02  35.8 Vb   21 ∞C
     Intake flush    5.00 L       16 sec  35.6 Vbl  Volume reached
     Sample         42.30 L      141 sec  35.7 Vbl  Volume reached

     02/17/15 11:57:58  35.8 Vb   22 ∞C
     Sample successfully sealed

  2  02/17/15 12:00:01  35.8 Vb   23 ∞C
     Intake flush    5.00 L       16 sec  35.6 Vbl  Volume reached
     Sample         42.31 L      141 sec  35.7 Vbl  Volume reached

     02/17/15 12:07:57  35.8 Vb   23 ∞C
     Sample successfully sealed
.  .  .  <-------------- Display shortened for brevity
End of EEPROM event backup cache.

 Terminate file logging operation now
 Press any key to continue.
```

Figure 3-18: EEPROM Data Backup Cache

<8> Contacting McLane

This option displays McLane contact information and includes the software version and instrument serial number.

```
Selection [] ? 8

               McLane Research Laboratories, Inc.
                    Falmouth Technology Park
                121 Bernard E. Saint Jean Drive
               East Falmouth, MA 02536-4444  USA

                  Email: McLane@McLaneLabs.com
                 Web: http://www.McLaneLabs.com
             Tel: 508-495-4000  Fax: 508-495-3333

                     Configuration: ZPS-30G
                    Source file: CF2-2_02.c
                  Electronics S/N: ML12345-01
                  Compiled: Jul 23 2014 13:24
```

Figure 3-19: McLane Contact Information

Programming a Schedule and Deploying the ZPS

This section provides steps for programming a schedule and launching a deployment. The collection schedule can begin at a specific date and time or via count-down timer.

IMPORTANT
Do not run the pump dry. If conducting a bench test, submerge the pump in water before committing to the deployment.

NOTE
Use a fresh battery pack for each deployment.

IMPORTANT
Use the file capture utility available in Motocross to log all communication with the ZPS. Refer to Chapter 2 in this User Manual for more information.

Sample Schedule

To program the sampling schedule and parameters and launch the deployment, complete the following steps:

1. Power on the computer and start Motocross.
2. Remove the dummy plug from the COM connector on the end cap and connect the COM cable to the computer.
3. Connect the COM cable to the computer serial port.
4. Connect the battery.
5. From the Main Menu select <5> Create Schedule.
6. Type 'N' at the prompt to retain the schedule that is already programmed (or 'Y' to enter a new schedule).
7. Enter the number of events to program and press [ENTER].

```
Enter the number of events to program  (0 to 50) ? 40
```

Figure 3-20: Enter Number of Sampling Events

8. Select Option <1>, <2> or <3> from the Schedule Menu to define the schedule start date and time and sample intervals.

```
_____________________________________________________________________

Configuration: ZPS-30G                  CF2 V2_02 of Jul 23 2014

                  ___________________________________
                            Schedule Menu
                  ___________________________________
                      Wed Feb 25 14:13:31 2015

                   <1> Enter each event time
                   <2> Enter start date & interval
                   <3> Enter start date & end date

                   <M> Main menu
```

Figure 3-21: Schedule Menu

9. Press [ENTER] to display a list of event numbers, dates and times. Review to confirm correct dates and times (press any key to scroll the display forward).

```
Schedule Verification

Event  1 of 40 at 02/28/15 16:10:00
Event  2 of 40 at 03/05/15 16:25:00
Event  3 of 40 at 03/10/15 16:40:00

Modify an event [N] ? y  <-------- Modify an Event

Enter the event number (1-40) [1] ? 2

Enter new date & time [03/05/2015 16:25:00] ? 03/10/15 16:25;:00

Schedule Verification

Event  1 of 40 at 02/28/15 16:10:00
Event  2 of 40 at 03/10/15 16:25:00
Event  3 of 40 at 03/10/15 16:40:00
```

Figure 3-22: Schedule Verification

10. Type 'N' to accept the sampling schedule (or 'Y' to modify an event).

Deployment

1. From the Main Menu, select <6>, Deploy System. The firmware aligns the belt to the first sample window if not already positioned, and measures the stepper motor distance to the next sample window. If the measurement to the next sample window is unsuccessful, the firmware displays a warning message, terminates the deployment and returns to the Main Menu.

2. The schedule and number of events to program can be accepted or changed. Type 'Y' to continue (or 'N' to make changes).

```
                Selection [] ? 6

02/25/15 14:20:18 Measuring steps between sample positions ...
02/25/15 14:20:18 Advancing belt to next sample position ... done

Clock reads 02/25/15 14:20:38.  Change [N] ? n

Existing deployment data file will be erased. Continue [N] ? y
Enter new deployment schedule [N] ? y

Current value of number of events to program: 50
Enter number of events to program (0-50) [50] ? 10
_____________________________________________________________
Configuration: ZPS-30G                CF2 V2_02 of Jul 23 2014
               ___________________________________
                         Schedule Menu
               ___________________________________
                   Wed Feb 25 14:21:00 2015
                <1> Enter each event time
                <2> Enter start date & interval
                <3> Enter start date & end date
                <M> Main menu
                Selection [2] ? 2
Enter START date and time [02/25/2015 14:21:04] ? 2/28/15 14:00:00
Enter interval
Days     (0-365) [  5] ? 5
Hours    (0- 23) [  0] ?
Minutes  (0- 59) [ 15] ?
Schedule Verification
Event  1 of 10 at 02/28/15 14:00:00
Event  2 of 10 at 03/05/15 14:15:00
Event  3 of 10 at 03/10/15 14:30:00
Event  4 of 10 at 03/15/15 14:45:00
Event  5 of 10 at 03/20/15 15:00:00
Event  6 of 10 at 03/25/15 15:15:00
Event  7 of 10 at 03/30/15 15:30:00
Event  8 of 10 at 04/04/15 15:45:00
Event  9 of 10 at 04/09/15 16:00:00
Event 10 of 10 at 04/14/15 16:15:00
Modify an event [N] ? n
```

Number of Events in Schedule

Figure 3-23: <6> Deploy – Schedule Confirmation

3. The Sampling Parameters display. Change or keep these values. When a parameter is changed, the list re-displays with the updated value.

NOTE
A Quick Reference description of each parameter is provided for reference in Appendix A.

```
Header <1> System Test
       <2> s/n 12345-01
       <3> User 01

Flush  <4> Back flush volume   [   5 liters]
                & time limit   [   1 minutes]
       <5> Back flush interval [   2 hours]
       <6> Sample delay        [   1 minutes]

Sample <7> Sample volume       [ 100 liters]
       <8> Pumping flow rate   [  20 liters/minute]
       <9> Minimum flow rate   [  10 liters/minute]
       <A> Pumping time limit  [  11 minutes]]

Data   <B> Pump data period    [   1 minutes]

       <D> Done

                Selection [] ?
```

Figure 3-24: <6> Deploy – Sampling Parameters

4. Type <D> to continue when the pumping parameters are acceptable.

5. The firmware performs a consistency check and prompts for any needed changes (for example, the countdown delay must be at least 1 minute long). Expired or overlapping events are also checked (event overlap is calculated based on maximum possible event duration including flushing, when pumped at the minimum flow rate). Prompts display if errors exist.

6. Next, the schedule overlap check is performed. If necessary, an overlap message displays.

```
Start times of events
       2   3   4   5
 occur before the time limits of the previous events expire.
 The listed events may begin later than their scheduled start
 times.  Any events that are actually delayed will take place
 as soon as earlier events are completed.

 Press any key to continue.
```

Figure 3-25: Schedule Overlap Message

NOTE

The overlap message is only a reminder and does not terminate the deployment. A schedule with intentionally short intervals may be entered for rapid sequential samples. When event overlap occurs, the start of the overlapping event is delayed until the current event is completed.

7. Accept the entries after the consistency check is completed. The reminder to offload data in EEPROM displays next.

The reminder is immediately followed by a line of diagnostic information as shown next.

```
Caution: Deployment will overwrite the EEPROM data backup cache.
System status: 02/25/15 14:26:46  33.9Vb  0mA  20.8∞C  Belt is aligned
```

Figure 3-26: Diagnostics

8. If the main battery voltage is too low to support the deployment, warnings will display (see Figures 3-4, 3-5 and 3-6 for more information about battery warnings).

9. After the status line (and battery warnings, if any), a final prompt displays. Type 'Y' to commit to the deployment (or 'N' to cancel and return to the Main Menu).

```
Proceed with the deployment [N] ? y
Warning: Programmed schedule will trigger a periodic
         back flushing event in 12 hours. This event
         will occur before the first scheduled sample
         event at 02/28/15 14:00:00. The ZPS system
         must be deployed before this back flush event
         occurs to avoid damage to the pump.
Proceed with the deployment [N] ? y
02/25/15 14:27:03
Erasing EEPROM entries ..........................
Remove communication cable and attach dummy plug.
System is ready to deploy.
Warning: Programmed schedule will trigger a periodic
         back flushing event in 12 hours. This event
         will occur before the first scheduled sample
         event at 02/28/15 14:00:00. The ZPS system
         must be deployed before this back flush event
         occurs to avoid damage to the pump.
02/25/15 14:27:09 Waiting for next periodic back flush @ 02/26/15 02:27:09
02/25/15 14:27:10 Suspended until 02/26/15 02:27:09 ... ?
```

Backflush Trigger Warning

Figure 3-27: Deploy – Proceed

The ZPS enters a monitor mode where no further entries (except [CTRL]-[C]) are allowed. An additional warning displays if periodic backflushing is programmed and the programmed schedule will trigger a back flush before the first scheduled sample. This warning reminds the operator to deploy the ZPS in time for the back flush event, prior to the first sample event.

10. Once the ZPS is ready to deploy, remove the communications cable and replace the dummy connector.

The firmware remains in Suspend mode and automatically wakes up and begins sampling at the scheduled time of the first pumping event.

NOTE
Unless interrupted by the operator, pumping begins whether or not the ZPS is on station. Reconnecting the COM cable and typing [CTRL]-[C] will terminate the deployment.

Notes

Chapter 4
Mechanical Description

Frame

The ZPS frame has an electro-polished, 316 stainless steel welded body. The frame can be an in-line component on a high-tension (up to 2,200 kg) ocean mooring system and has a built-in top bridle and four mooring eyes at the bottom for a chain or cable bridle. Each mooring eye accommodates a 5/8" shackle, and has an insulator to protect the frame from corrosion. The frame provides extra mounting space near the controller housing for other instruments.

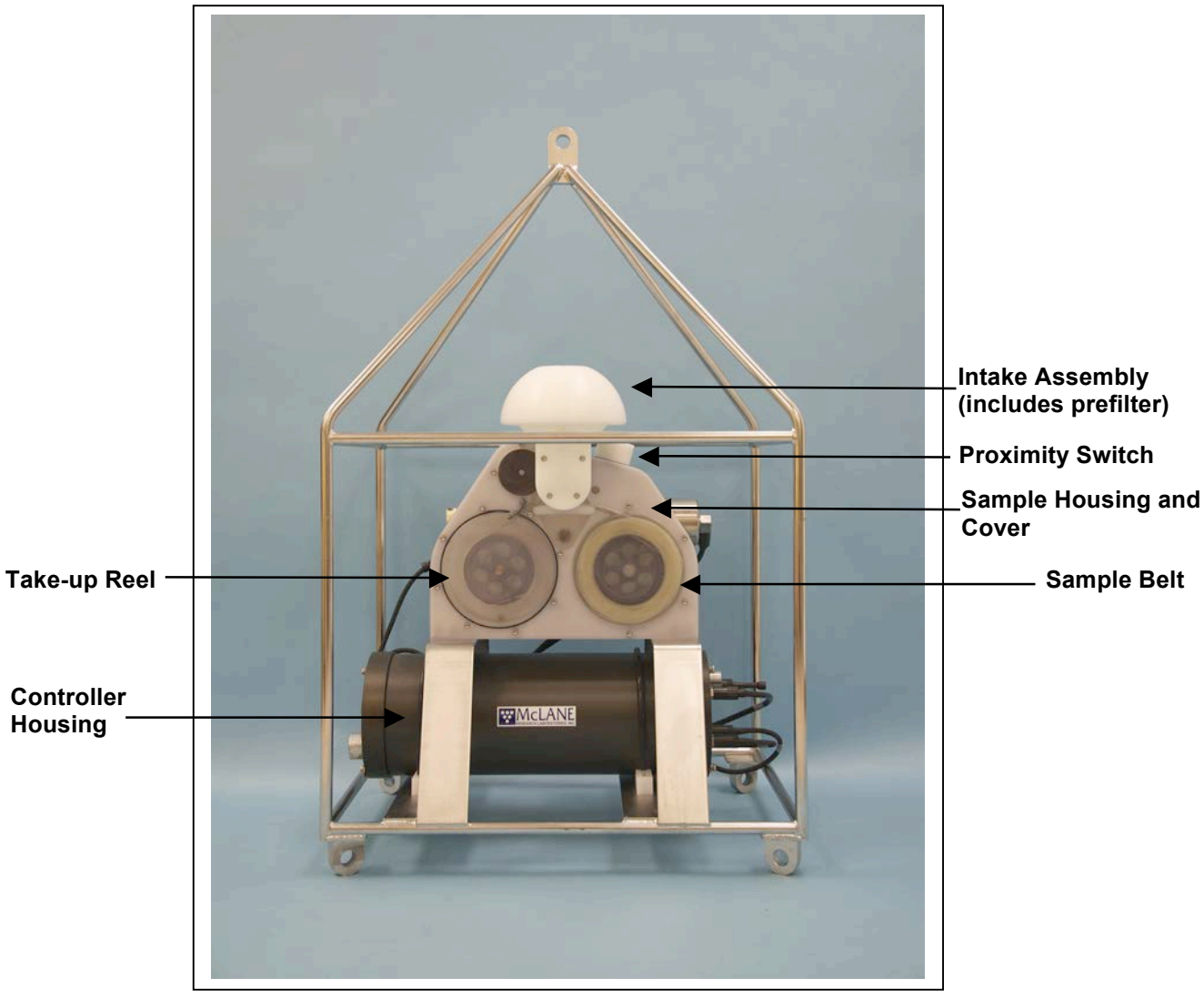


Figure 4-1: ZPS Full View

Controller Housing

The controller housing is a heat-treated aluminum alloy pressure cylinder that is pressure resistant to 5,000 meters. The housing holds the ZPS battery pack, backup batteries and electronics. Two latex rubber-insulated 316 stainless steel u-bolts secure the controller housing to the ZPS frame. Two sacrificial zinc anodes (one attached to each end of the controller housing) provide galvanic protection from corrosion.

Figure 4-2: ZPS Controller Housing

Top and Bottom End Caps

The battery pack and electronics (a micro-controller, 3-phase pump motor driver and stepper motor driver) are fastened to the inside of the top end cap. Both the top and bottom end caps have a face o-ring and a radial o-ring (with a radial back-up ring) to seal the controller housing against water intrusion.

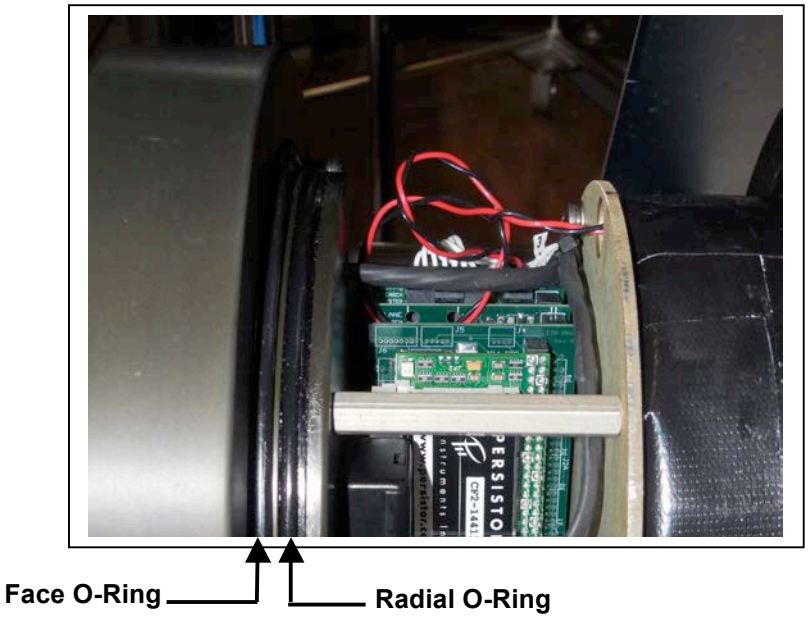


Figure 4-3: Controller Housing Top End Cap with O-Ring Seals

IMPORTANT
O-ring maintenance is important to keep the controller housing end caps from water intrusion. See Chapter 8 “Maintenance and Storage”, for details about o-ring maintenance.

End Cap Bulkhead Connectors

The end cap has bulkhead connectors for the COM Port, Pump, Belt Motor, and Proximity Sensor (Figure 2-4).

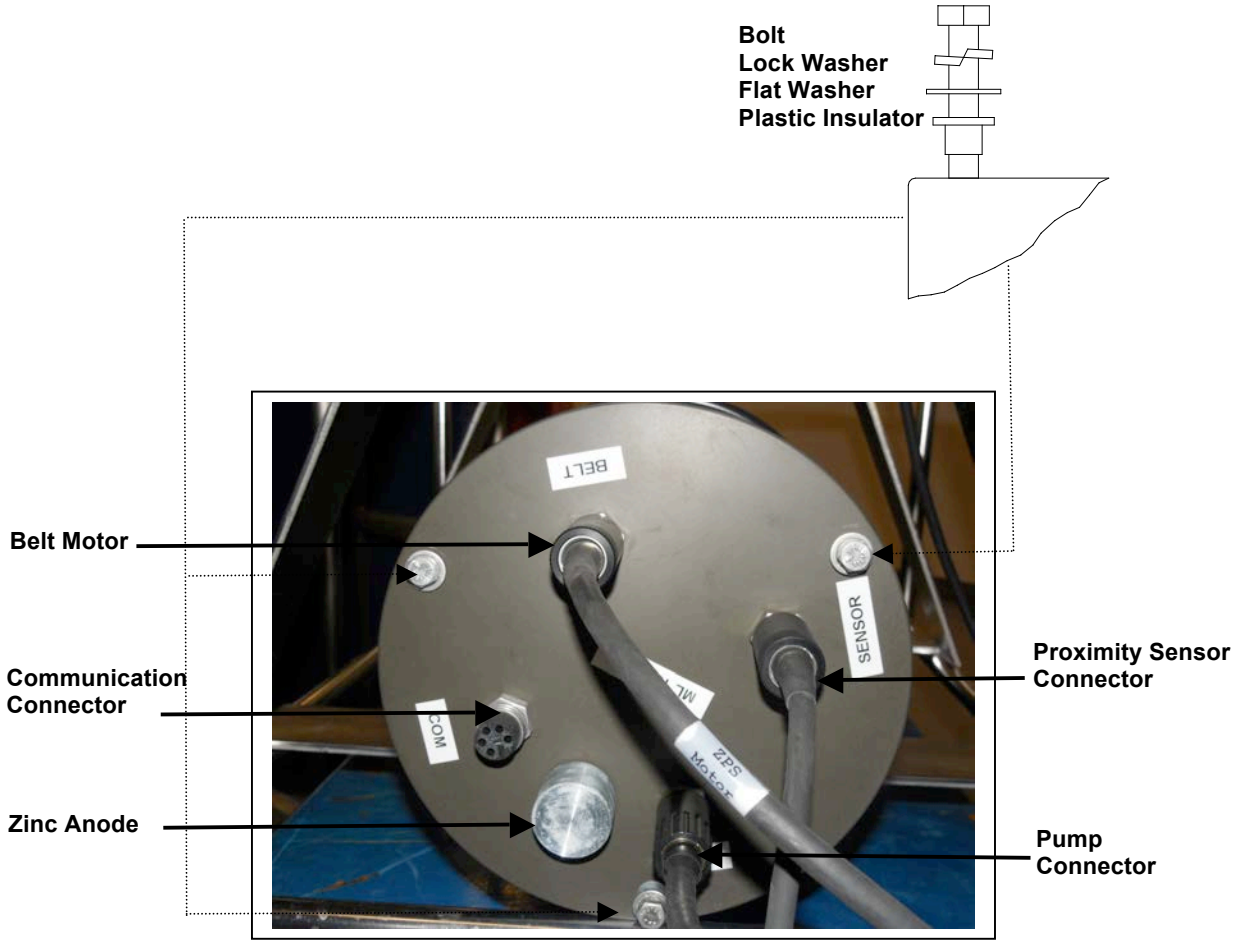


Figure 4-4: Controller Housing End Cap Bulkhead Connectors

End Cap Bolts, Plastic Inserts and Screw Holes

Three bolt/washer assemblies hold the controller housing end cap in place. A white plastic insert goes into the controller housing screw hole, followed next by a flat washer, spring (lock) washer, and lastly, the bolt. Tighten the bolts until the lock washers become flattened (approximately 20 in-lb). All hardware is type 316 stainless-steel. A 7/16" nut driver is included in the toolkit.

NOTE
Do not over- tighten the end cap bolts (use approximately 20 in-lb of torque).

Pump

The pump is located downstream from the sample belt to prevent damage to collected specimens (zooplankton do not pass through the pump during the collection process). The pump assembly includes a 3-phase brushless DC motor and the pump head. The motor is sealed in a titanium pressure housing and magnetically coupled to the pump head. The pump head is Hydex 4101 (PBT) and the rotors are Tectron HPV (PPS). Dual rotary pistons provide accurate, even flow throughout the 12 – 30 liter per minute pump range. The shaft and cams are Ferralium (F-255) and the bearings are fiberglass reinforced Teflon.

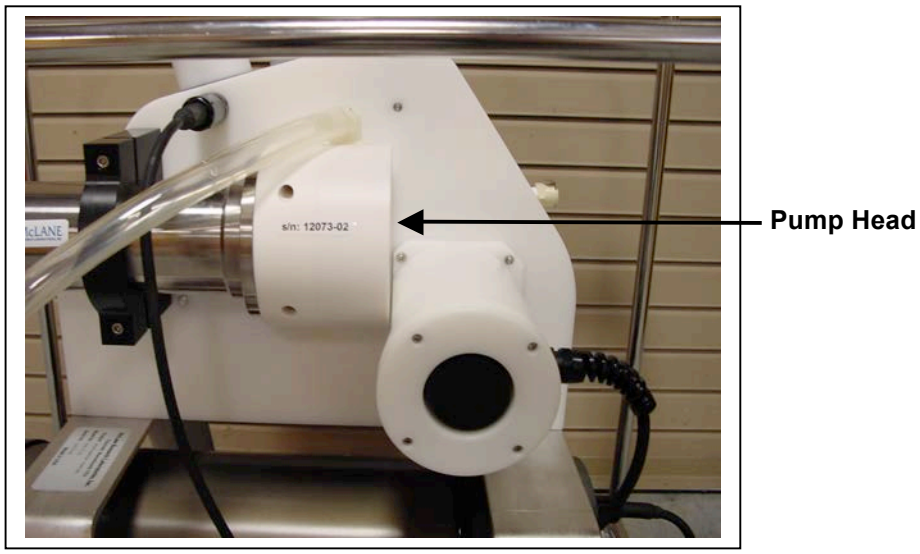


Figure 4-5: Pump Head

Intake Dome

The hemispherical shape of the intake dome creates a uniform flow path around the intake regardless of the direction of any currents. The horn-shaped intake is designed to produce low velocity gradients, increasing to maximum velocity inside the intake tube. A coarse screen is recommended at the top of the intake dome to prevent large materials and organisms from entering the sample chamber. Copper screens in 2 mm and 5 mm sizes are provided in the toolkit. Since the intake dome is pointed upward, settling particles may collect in the intake between samples. Backflushing prior to each deployment to clear the sample mesh and intake of any unwanted material.

Sample Belt and Stepper Motor

The ZPS uses a 50 position belt for sample collection (the belt actually contains a total of 54 sample windows). The belt is composed of a continuous strip of polyester mesh sandwiched between urethane layers in which mesh sample windows have been formed. Each mesh window is a collection well that minimizes crushing damage to collected specimens. The covering polyester mesh strip isolates the sample as it is wound onto the take-up spool in the fixative reservoir. Secondary mesh windows alternate between the larger sample windows and provide a flow path for water as the belt is advanced at the conclusion of each sample acquisition. Pumping continues at a reduced rate as the belt advances to prevent the escape of collected zooplankton.

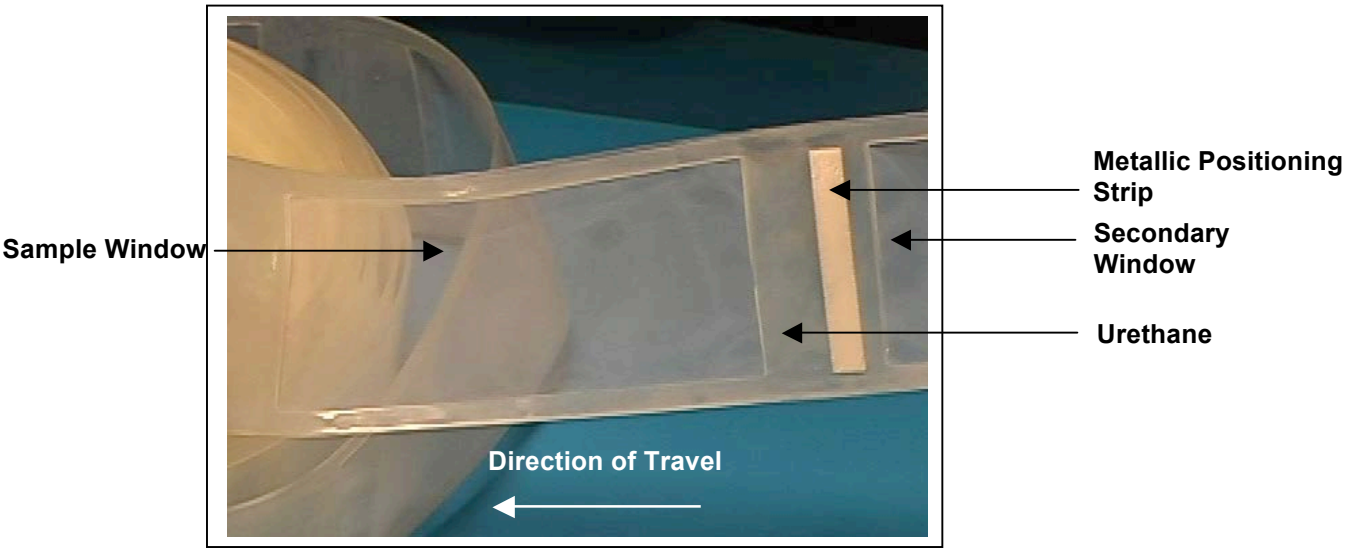


Figure 4-6: Sample Belt

The belt is advanced by a stepper motor under the control of the microcontroller. The stepper motor is mounted inside an oil filled (Dow Corning 200 fluid, 20 cSt), pressure compensated, plastic housing and is coupled to the take-up spool through a gear box.

Sample windows are precisely positioned in the flow path by a proximity sensor that senses metallic strips embedded in the belt between the urethane layers.

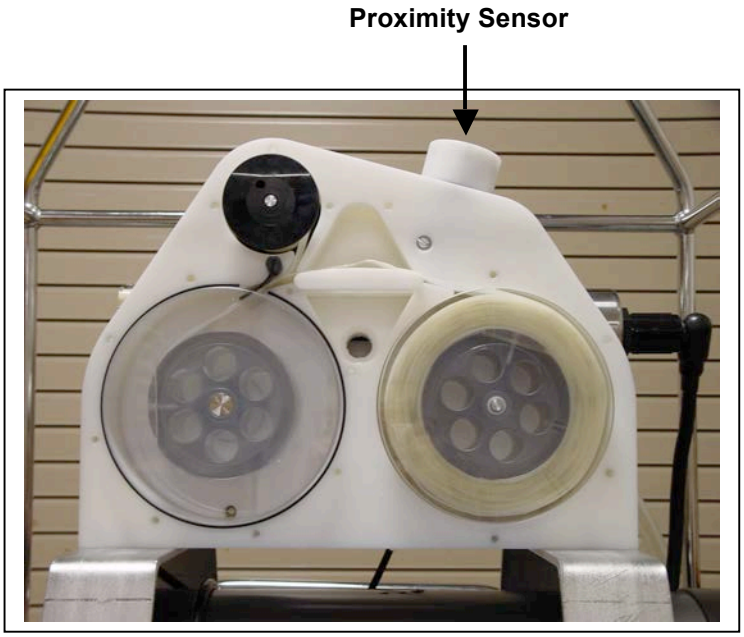


Figure 4-7: Proximity Switch

Serial Number

The frame contains a serial number label. The controller housing end cap, pump assembly, belt motor assembly and firmware menu also display the serial number.

Figure 4-8: ZPS Serial Number Label

Notes

Chapter 5
Electronics Description

The ZPS controller electronics is a four board stack mounted on the chassis plate between the controller housing end cap and the battery holder. The table below describes each board.

Board	Use
CF2 Microcontroller Board	Low power data logging.
CF2 Interface Board	Controls the signals from the Microcontroller to the AUX Stepper.
AUX Stepper Board	Powers communications and Sample Belt.
Three Phase Board	Runs the pump. As material collects, a pump speed algorithm adjusts differential pressure across the active sample window. Flow rate adjusts to prevent sample or mesh damage and lower battery drain. If rapid intake clogging occurs, pumping stops to protect the sample.

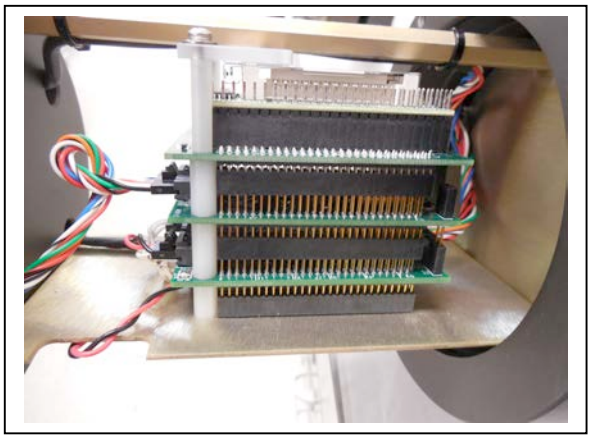


Figure 5-1: CF2 Four Board Stack

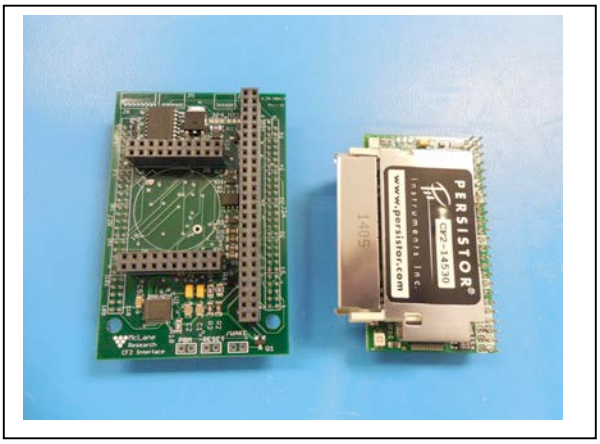


Figure 5-2: Microcontroller & Interface Board

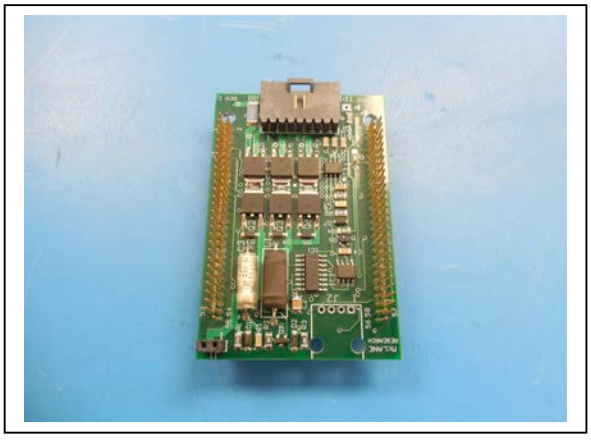


Figure 5-3: Three Phase Board

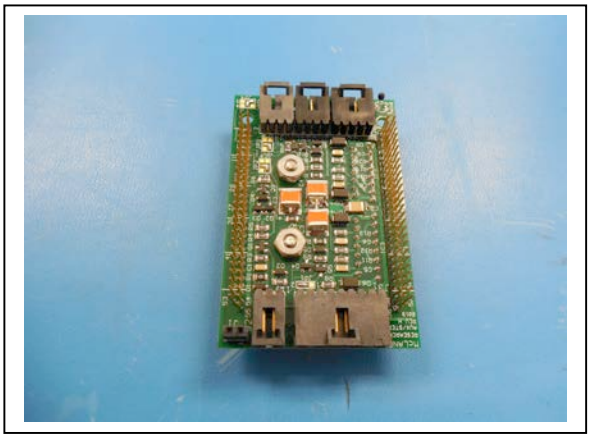


Figure 5-4: AUX Stepper Board

IMPORTANT
Take standard electrostatic discharge (ESD) precautions when handling the electronics.

Battery Connection

Connecting and disconnecting the main battery is the only way to switch the ZPS on and off. The firmware starts automatically when the main battery is connected.

IMPORTANT
The backup batteries will not power on the sampler.

When new, the A72-1000 alkaline battery pack delivers approximately 30,000 mAh. The main battery positive and negative terminators are fed through the top battery plate for connection to the 2-pin connector on the middle board of the electronics stack. The main and back-up connectors are different to prevent misconnection.

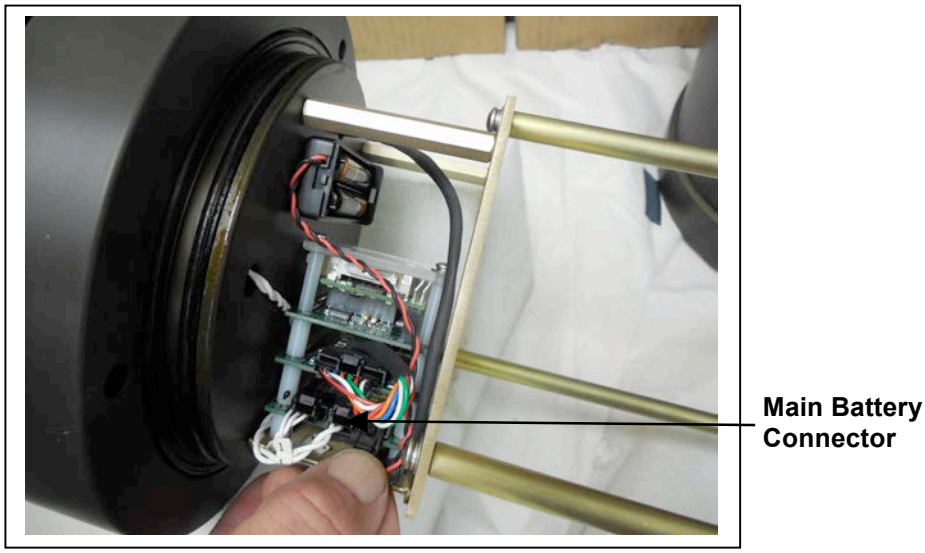


Figure 5-5: Battery Connection

Chapter 6
Operations

The sample belt, prefilter, and intake path must be cleaned before every deployment (the ZPS ships with these parts installed therefore cleaning is unnecessary for the first deployment). Estimated battery endurance can also be determined with the sample calculation in this Chapter.

NOTE
The ZPS media includes video clips that also illustrate preparing and installing the ZPS sample belt and attaching the cover and intake. See Appendix B in this User Manual for a video list.

Cleaning the Belt, Prefilter and Intake Path

The sample belt, prefilter and intake path should be cleaned before each deployment using the following steps:

NOTE
If required, first use a quick disconnect hose (in the toolkit) to drain fixative from the reservoir.

Figure 6-1: Quick Disconnect for Draining Fixative

1. Remove the 4 screws attaching the prefilter to the sample cover and carefully remove the prefilter.

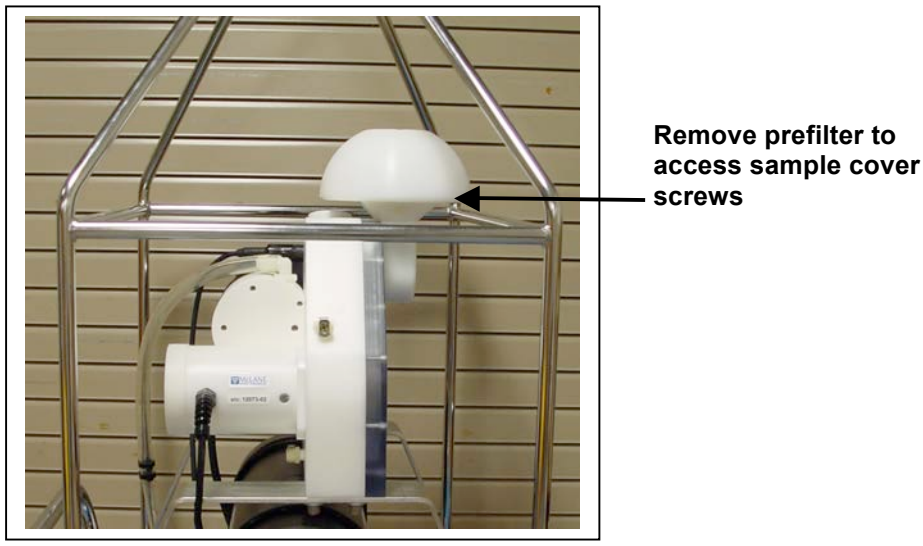


Figure 6-2: Prefilter

2. Remove all screws from the sample cover plate face and lift off the cover.

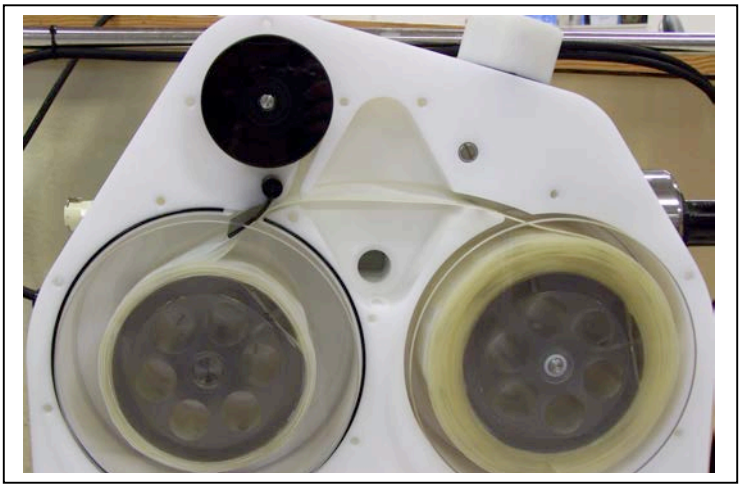


Figure 6-3: ZPS with Sample Cover Removed

3. Remove and clean the rubber flapper valve.

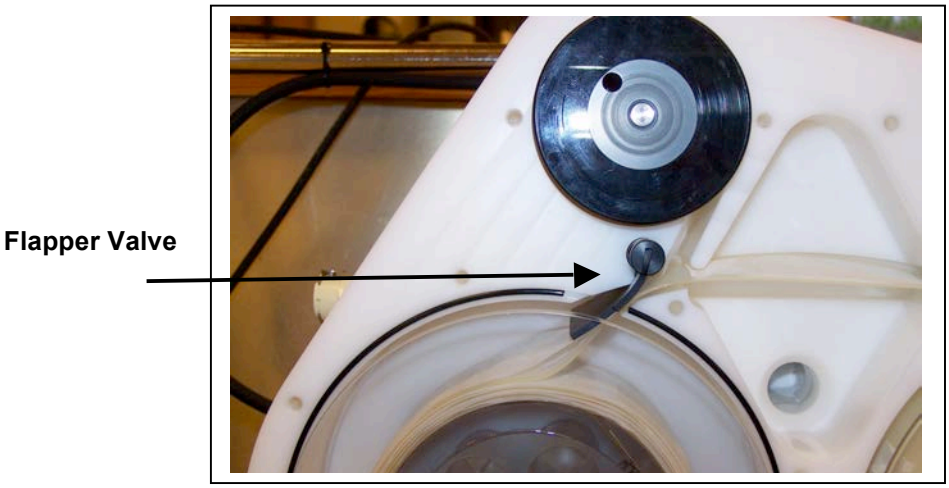


Figure 6-4: Reservoir O-Ring Cord and Rubber Flapper

4. Slide the support grid straight out of the sample housing to remove.

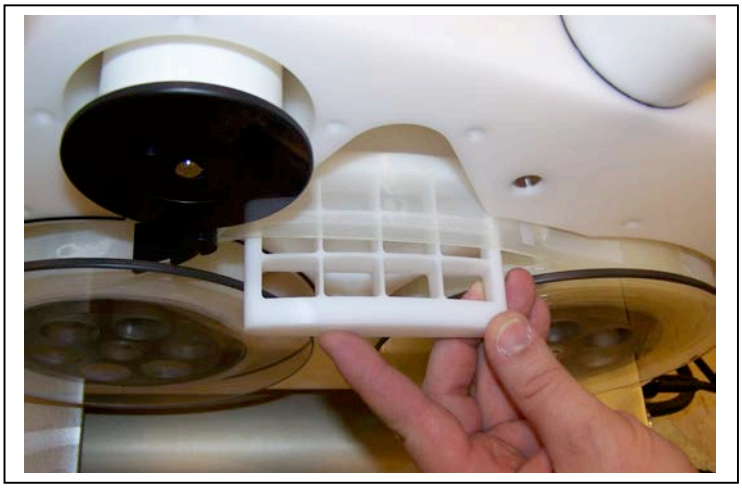


Figure 6-5: Remove Sample Support Grid

5. Remove the sample belt and carefully slide the sample, take-up and cover reels off the shafts.

6. Using a 3/16" hex driver, remove the prefilter retaining ring from the top of the intake assembly.

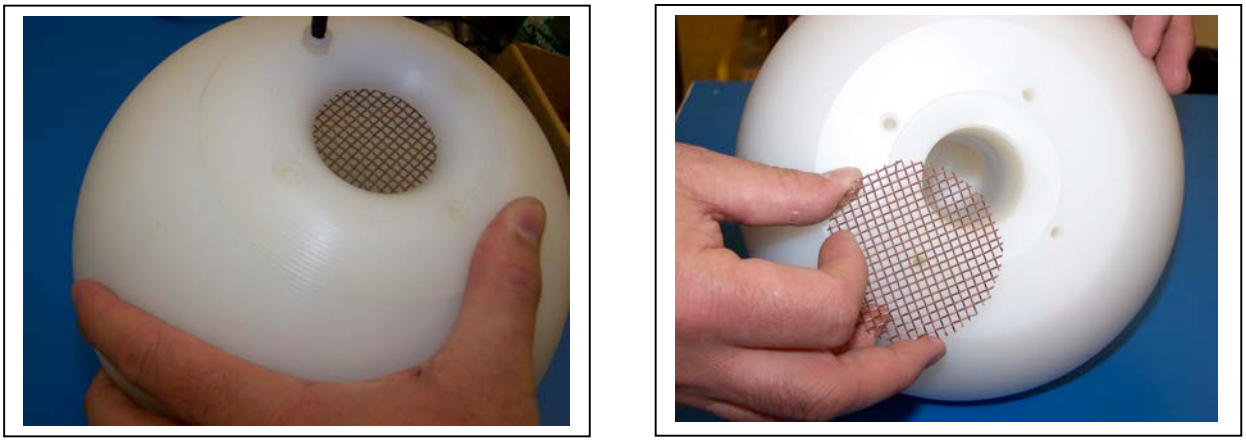


Figure 6-6: Remove Prefilter Retaining Ring and Prefilter

7. Remove the prefilter and inspect it for damage and wear. Replace if necessary.

8. Clean the prefilter with a mild detergent solution and clean, neutral water.

9. Clean the retaining ring, intake assembly, sample housing, support grid, and sample cover with a mild detergent solution and clean, neutral water.

10. Examine the reservoir o-ring cord, feeling for cracks or other damage, and replace if necessary.

11. Clean and re-grease the cord and groove and reinstall the cord.

NOTE
There is a break in the reservoir o-ring cord through which the belts enter the reservoir. Confirm that the reservoir o-ring cord is seated in its groove in the sample housing.

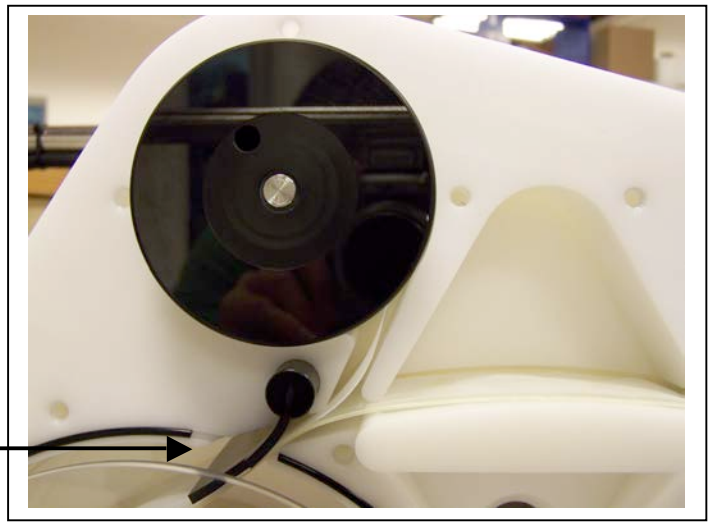


Figure 6-7: Break in O-Ring Cord

12. Examine the intake assembly o-rings, feeling for cracks or other damage and replace if necessary.

13. Clean and re-grease the o-rings and their grooves. Reinstall the o-rings.

14. Reinstall the prefilter with the retaining ring, and reinstall the support grid.

15. Cover the sample belt and spools with a mild detergent solution and clean, neutral water.

Reassembling the Sample Belt

The ZPS belt and spools are shipped in the proper orientation, which is critical for successful ZPS operation and minimal specimen damage. When the belt is reassembled after cleaning, confirm that the belt is orientated with the thick side up.

IMPORTANT
The two urethane layers sandwiching the polyester mesh of the sample belt are not the same thickness – orienting with the thick side on top provides a deeper sample well (and greater crush protection for the collected zooplankton).

To reassemble the Sample Belt, complete the following steps:

1. Check the spool clamps and make any necessary adjustments.
2. Attach the belts, correctly orienting them on the spools.

IMPORTANT
As the belt advances onto the take-up spool, the large sample window should be leading each group of windows in this order: sample window, metallic proximity strip, smaller secondary window, solid section.

3. Carefully roll the belts fully onto the sample belt and cover spools by hand.
4. Install the belts and spools in the sample housing, confirming that the belts are lying on their guides and are free to slide. The spools should be free to rotate.
5. Reinstall the sample cover and the intake assembly. Seat the reservoir o-ring cord and intake tube assembly properly and check for grit or other material that affects the seal.
6. Attach a quick disconnect hoses (provided in the tool kit) to the reservoir fill hole and fill the reservoir with fixative. Watch through the clear sample cover to see when the reservoir is full. Stop filling the reservoir when the fixative reaches the flapper valve in the channel where the belts enter the reservoir. If the fixative fills the fill hole, the valve prevents the flow of fixative into the intake path.

7. Disconnect the hose (the quick disconnect fitting mounted in the sample housing automatically seals the fill hole).

Moving the Sample Belt onto the Take-up Reel

The sample belt must be moved onto the take-up reel prior to deployment. Moving the sample belt can be completed by winding by hand or using Option <2> in the Manual Operation menu. Chapter 3 in this User Manual has more details about the Manual Operation menu.

Estimated Battery Endurance

The values for pumping and moving the belt include the current drain of the controller, which is awake during pumping and belt movement. Using the table below, the operator can estimate battery life for the proposed deployment schedule. An example of a battery life estimate for a three month deployment is shown next.

Controller unit	2.0 mA
Controller unit in Suspend mode	0.30 mA
Pump operation (20 L/min)	500 mA
Controller unit advancing the sample belt (requires~30 sec or 3.75mAh)	450 mA

Example of Determining Battery Life for Three Month Deployment

Pre-deployment	
Controller unit (3 hours)	3 h x 2.0 mA = 6.0 mAh
Advance belt twice	2 x 3.75 mAh = 7.5 mAh
Pumping (1.5 minutes)	0.025 h x 500 mA = 12.5 mAh
	Subtotal = 26.0 mAh
Deployment	
Controller (3 months)	2160 h x 0.30 mA = 648.0 mAh
Advance belt (50 samples)	50 x 3.75 mAh = 187.5 mAh
Pumping (11 minutes / sample plus backflush)	9.2 h x 500 mA = 4600.0 mAh
Pumping (1 minute backflush twice per day)	3 h x 500mA = 1500.0 mAh
	Subtotal = 6935.5 mAh
Recovery (offload data/remove samples)	
Controller unit (2 hours)	2 h x 2.00 mA = 4.0 mAh
Complete belt take-up	2 x 3.75 mAh = 7.5 mAh
	Subtotal = 11.5 mAh
Total Battery Consumption	**26.0 + 6935.5 + 11.5 = 6973.0 mAh**

In this example the total energy consumed is less than the 30,000 mAh capacity of the battery and the proposed deployment plan will not exceed battery life.

Chapter 7
Deployment and Recovery

The ZPS can be deployed on different mooring types. As part of a mooring, the ZPS can be used as a bottom tethered or floating "in-line" instrument. For profiling applications less than 5,000m the ZPS can be lowered from a ship by a winch. After the ZPS is recovered, data is offloaded using the firmware.

NOTE
If possible, do not deploy or recover the ZPS through an oil-slick (oil may damage the pump). If an oil slick is unavoidable, pour clean, fresh water over the spot where the ZPS will enter or break the water surface through the slick, and rinse the ZPS thoroughly after recovery.

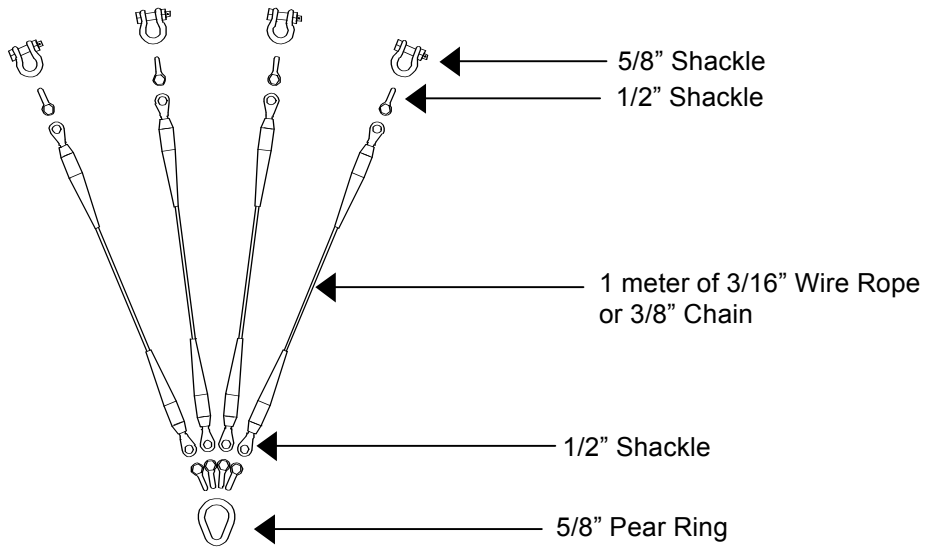


Figure 7-1: Four-to-One Bridle Connection

Deployment Preparation

Preparing and deploying the ZPS for deployment requires the following (in order of completion):

- Connect the battery.
- Close the end cap.
- Connect the COM cable.
- Program the deployment.
- Disconnect the COM cable and attach the dummy plug.
- Deploy the ZPS.

Recovery Procedure

Post-recovery steps include the following:

- Offload the deployment data.
- Remove the sample belt.
- Remove the specimens.

Removing the Belt

This procedure explains removal of the sample belt and zooplankton samples. When the deployment schedule completes, the firmware enters Suspend mode. After recovering the sampler and moving to a dry place, connect to the controller using the steps in Chapter 2 "Communicating with your McLane Instrument".

Wake the ZPS by pressing [CTRL]-[C] three times (pause one second between each press). The prompt to complete belt take up displays (this winds the sample belt onto the take-up spool in the fixative reservoir). Type 'Y' to instruct the firmware to complete take-up and return to the Main Menu.

```
Complete belt take-up now (Yes/No) [Y] ? y
```

Figure 7-2: Complete Belt Take-up

IMPORTANT
Confirm that the sample belt is completely wound onto the take-up spool in the fixative reservoir before beginning this process. The belt can be advanced manually, or using option <2> 'Advance to end of belt' in Manual Operations.

1. Drain the fixative reservoir using a quick disconnect plug (provided in the toolkit). Look through the clear sample cover to confirm that the fixative is draining.
2. Disconnect the hose. The quick disconnect fitting mounted in the sample housing will automatically seal the drain hole.
3. Remove the intake assembly and the sample cover.
4. Slide the take-up spool and belts off of the take-up shaft and take the samples to a laboratory space for processing. If taking-up the sample belt by hand rather than using the take-up utility, remove all three spools and the attached belt from the sample housing. Then, carefully complete the take-up by hand.
5. Wind the belt tightly to protect the samples until they can be recovered under controlled conditions. A spare take-up spool is included with a new sample belt for the next deployment.

IMPORTANT
If the samples cannot be removed from the belt for some time, secure the belts from unwinding and immerse them on the take-up spool, in a fixative bath.

Removing Zooplankton Specimens

1. To remove specimens from the belt, unwind it sufficiently to expose a single sample window.
2. Carefully peel back the cover belt and, using neutral water, flush through the mesh of both belts to gently rinse the specimens onto a labeled sieve or filter.
3. Repeat for each sample, confirming that all specimens have been removed from the belts and captured on a sieve for archiving and analysis.

Offloading Data

Once steps are completed to recover the ZPS, data can be offloaded. This section contains instructions for running the data offload. The deployment data will display on screen and a log file can be created for use in analysis.

This procedure can be repeated because deployment data remains in memory until a new deployment schedule is created or the batteries are drained and/or removed.

IMPORTANT
Do not disconnect the battery (which erases the data) until checking the capture files to confirm that the data offload was successful.

Before offloading data, see post-deployment steps in Chapter 6 "Operations' such as completing sample belt take up. To use the Offload Data option, complete the following steps:

1. Start Motocross on the host computer (see Chapter 2 in this User Manual for Terminal emulation details).
2. Within Motocross, specify a "Capture file" for the offloaded data.
3. If necessary, turn the capture 'On' by pressing [ALT]-[Z].

4. Connect the COM cable to a computer and then connect the COM cable to the ZPS.

IMPORTANT
The computer should be on and Motocross running before connecting to the ZPS electronics.

5. From the Offload/Display Data File Menu select option <1>, <2>, <3>, or <4> to display recorded data.

```
_____________________________________________________________
Configuration: ZPS-30G                  CF2 V2_02 of Jul 23 2014
               ___________________________________
                   Offload/Display Data File
               ___________________________________
                   Tue Feb 17 13:34:46 2015

                <1> Display all data
                <2> Display summary data
                <3> Display pump data
                <4> EEPROM backup cache

                <M> Main Menu

                Selection [] ?
```

Figure 7-3: Offload/Display Data File

The screens that follow show Option <1> 'Display ALL Data'.

6. Press any key to offload the data and display to the screen (the data is saved to the Capture filename specified in Step 2). An example data offload file is shown next.

```
To copy the instrument data file to a disk file, initiate
your communication program's file logging command now and
then press any key to start the transfer.  The instrument
data file will remain resident and is not erased by this
offload procedure.
```

Figure 7-4: Begin Data Offload (All Data)

<1> Display ALL data

'Display ALL data' displays the entire data file including programmed sample parameters.

```
Selection [] ? 1


To copy the instrument data file to a disk file, initiate
your communication program's file logging command now and
then press any key to start the transfer.  The instrument
data file will remain resident and is not erased by this
offload procedure.

Configuration:     ZPS-30G
Software version:  ZPS-2_02.c
Compiled:          Jul 23 2014 13:24:38
Electronics S/N:   ML13318-01

Data recording start time: 02/17/15 11:47:12
Data recording  stop time: 02/17/15 13:08:14

HEADER
______
Bench Test, 2-17-2015
s/n 12345-01
Test User

SAMPLE PARAMETERS
_________________
Initial flow rate:     20 liters/minute
Minimum flow rate:     10 liters/minute
Sample volume:         40 liters
Time limit:             5 minutes
Back flush volume:      5 liters
Back flush interval:  720 minutes
Sample delay:           5 minutes
```

Figure 7-5: <1> Display All Data (1 of 2)

```
SCHEDULE

________
Event 01 of 08 @ 02/17/15 11:50:00
Event 02 of 08 @ 02/17/15 12:00:00
Event 03 of 08 @ 02/17/15 12:10:00
. . .
DEPLOYMENT DATA

_______________
  1  02/17/15 11:50:02  35.8 Vb   21 ∞C
     Intake flush    5.00 L       16 sec  35.6 Vbl  Volume reached
     Sample         42.30 L      141 sec  35.7 Vbl  Volume reached
     02/17/15 11:57:58  35.8 Vb   22 ∞C
     Sample successfully sealed

  2  02/17/15 12:00:01  35.8 Vb   23 ∞C
     Intake flush    5.00 L       16 sec  35.6 Vbl  Volume reached
     Sample         42.31 L      141 sec  35.7 Vbl  Volume reached
     02/17/15 12:07:57  35.8 Vb   23 ∞C
     Sample successfully sealed

 3  02/17/15 12:10:02  35.8 Vb   24 ∞C
     Intake flush    5.00 L       16 sec  35.6 Vbl  Volume reached
     Sample         42.31 L      141 sec  35.7 Vbl  Volume reached
     02/17/15 12:17:57  35.8 Vb   23 ∞C
     Sample successfully sealed
. . .
PUMPING DATA

_____________
Sample interval: 1 minute
event  L/min  Liters  Vbat

    1  19.96   19.25  35.7
    1  19.96   38.46  35.7
    2  19.96   19.26  35.7
    2  20.02   38.47  35.7
    3  20.02   19.26  35.7
    3  20.02   38.47  35.7
. . .
End of instrument data file.

Terminate file logging operation now.


 Press any key to continue.
```

Display shortened for brevity

Display shortened for brevity

Display shortened for brevity

Figure 7-6: <1> Display All Data (2 of 2)

7. After the data is offloaded, stop the Motocross file capture.

IMPORTANT
The Offload option can be repeated if necessary (the data file remains in memory until a new deployment schedule is created or the batteries are disconnected).

8. From the Main Menu, select <4> Sleep to put the firmware into Suspend mode.
9. Disconnect the COM cable from the controller and reinstall the dummy plug.

Chapter 8
Maintenance and Storage

Several maintenance operations should be performed before and after deploying the ZPS to ensure smooth operation and long instrument life. Rinse the entire instrument assembly with clean fresh water after every deployment to prevent corrosion. Also clean and flush the intake assembly. Before and after each deployment also inspect the following:

- O-rings
- Prefilter
- Bolts
- Controller Housing
- Cables

Cleaning and Inspecting the Controller Housing

Prior to each deployment, inspect, and if necessary, replace the zinc anodes attached to the controller housing end caps. When installing new zincs, use 316 stainless steel hardware and include the plastic insulator bushings.

IMPORTANT
Keep hard objects such as tools or shackles away from the controller housing. Scratches from these objects will localize galvanic action and can cause deep crevices or pitting.

O-Rings

A set of o-rings seal both controller housing end caps from water intrusion. Each set includes 3 o-rings – 2 round-section o-rings (BN70-2-259 and BN70-2-256) and one backup ring (BN90-8-256).

Position the larger (2-259) o-ring in the axial groove to seal against the face end of the controller housing. Fit the smaller (2-256) round section o-ring and the backup ring (8-256) in the radial seal groove. Position the backup ring on the low pressure side of the radial groove (toward the interior of the controller housing). The backup ring has a concave side facing toward the round o-ring. The accompanying o-ring is seated on the concave side (high pressure side) of the backup ring.

Inspect o-rings regularly for signs of wear and any foreign material (which can cause leaks). Look for small cracks and feel for grit, sand or hair. O-rings should be cleaned with alcohol and lubricated with a thin coating of o-ring grease as necessary. When inserting the end cap into the controller housing, ensure that the face o-ring remains seated in its groove and that the radial o-rings enter the housing uniformly without pinching.

Sample Housing and Proximity Switch

The metal portion of the quick disconnect fittings (used to fill the fixative reservoir) is 304SS. Check the quick disconnects to ensure they are not worn (spare fittings are provided in the toolkit).

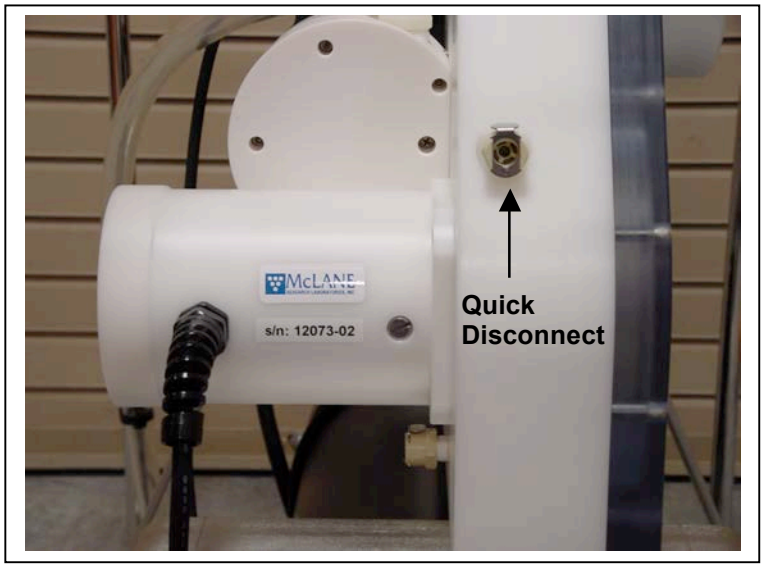


Figure 8-1: Fixative Reservoir Quick Disconnect

The proximity switch for belt position is mounted in the sample housing inside an oil filled, pressure compensated, reservoir. Before a deployment, push gently on the bladder at the top of the reservoir to verify oil is full. Add oil if there is little or no resistance or the bladder has collapsed. Fill with Dow Corning 200 fluid, 20 cSt (the same fluid used to pressure compensate the stepper motor housing).

The fill hole is in the front face of the sample housing, under the sample cover.

IMPORTANT
Turn the ZPS onto the side so that the fill hole faces up before adding oil. Gently pressing the bladder while filling will help remove trapped air from the reservoir.

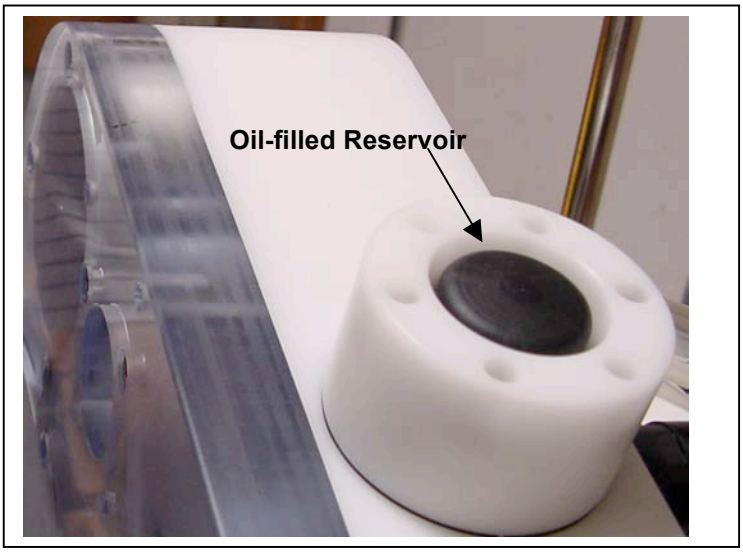


Figure 8-2: Proximity Switch Oil Reservoir

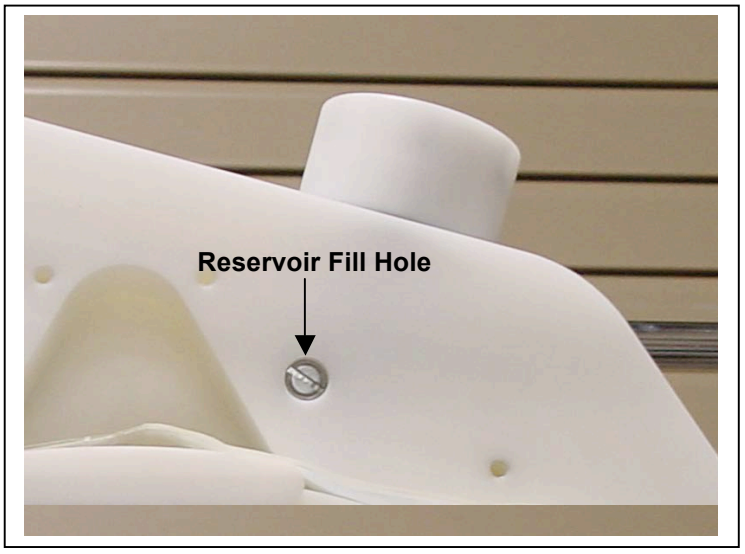


Figure 8-3: Oil Reservoir Fill Hole

Battery Maintenance

The capacity of a new ZPS A72-1000 alkaline battery pack is approximately 30,000 mAh.

IMPORTANT
Use a new battery pack for each deployment.

Battery Replacement

Diagnostics, (Option <2> from the Main Menu) displays the no-load battery voltage. A warning message displays if the battery is below 28 volts. A battery below 28 volts should be replaced if a full deployment is planned.

IMPORTANT
Before replacing the battery, offload all data. Disconnecting the main and backup batteries erases all deployment data stored in memory.

Backup Batteries

The backup battery consists of two AAA alkaline batteries. This backup can sustain the non volatile controller memory for many months in the event of a main battery failure. However, the backup batteries will not power on the sampler.

IMPORTANT
Do not make contact with battery terminals reversed. Install the backup battery with the battery terminals to correctly fit the holder terminals.

Storage

The shipping crate is a reusable international freight container that is ISPM-15 compliant for international transport.

IMPORTANT
To prevent instrument damage during transport or storage, crate should remain upright. Avoid excessive vibration and extreme temperatures for prolonged periods of time.

There are several procedures to complete before packing the ZPS in the crate for longer than one month:

- Offload all data from memory.
- Rinse all instrument components with fresh water.
- Remove main and backup batteries. If the main battery is still usable, first cover the connector with insulation tape and then store the battery in a refrigerator.
- Reassemble the main battery holder and insert the electronics package back into the controller housing.
- Replace all bolts and apply a small amount of anti-seize to the threads.

Notes

Appendix A
Quick Reference to Sampling Parameters

ZPS Sampling Parameters - Quick Reference

Header: Three lines of text (up to 65 characters per line) entered as a file header and offloaded with the data. The header could be project name, deployment location or instrument number.

Back Flush Volume: Amount of water flushed backwards through the sample window mesh and along the intake path before sampling. This can occur periodically between sample events, not just immediately before a sample is taken. Disable by setting to 0.

Back Flush Time Limit: Maximum time for the back flush prior to sampling. Time limit is displayed for information only (limit cannot be directly set as it depends on flushing volume and minimum flow rate).

Back Flush Interval: Interval between back flush events. Backflushing removes unwanted organic and particulate material from the intake path and sample window mesh and prevents the growth of material. Disable by entering 0.

Sample Delay: Time between back flush and sample. The delay allows for ambient conditions to re-establish in the sampling location after the back flush. Delay occurs independently of the periodic back flushes. Disable by setting to 0.

Sample Volume: Amount of water to filter when a sample is taken. The pump automatically turns off when this volume is reached unless it has already shut down by a preset flow rate or pumping time limit.

Pumping Flow Rate: Initial pump flow rate. The firmware may adjust flow rate during sampling to reduce differential pressure across the sample window mesh.

Minimum Flow Rate: If the flow rate drops below this value before the sample volume is reached, the pump will turn off.

Pumping Time Limit: Maximum time for each sample before pumping is terminated. This sets a time rather than volume to limit sample collection. The minimum and maximum allowed values depend on the sample volume, flow rate, and minimum flow rate.

Pump Data Period: Sampling time of pump flow rates and volumes stored during each sampling event.

Appendix B
Training Videos

There are several training videos available for the ZPS. These videos are included on the media that ships with a new sampler and can also be downloaded from the McLane website at: http://www.mclanelabs.com/product-type/samplers/zps-videos.

A description of each video and content is provided below for reference.

Video	Content
Installing the Battery and Controller	Reviews installing the ZPS battery and controller.
Loading Belt Reels	Reviews loading belt reels.
Loading Sample Housing	Reviews loading the sample housing.
Installing Sample Cover and Intake	Reviews installing the sample cover and intake.